The Blast Furnace and Steel Plant

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Unfinished Correspondence

IT is unfair to an author to select suggestive passages from his literary or diplomatic effort without full appreciation of the surrounding context. ¶ A recent booklet distributed for editorial comment contains the verbatim correspondence which has passed between Warren G. Stone, President of the Brotherhood of Locomotive Engineers, and Thomas G. Lewis, President of the United Mine Workers, concerning the operation of certain coal mining properties bought and financed by members of the railroad organization. President Stone, acting as chairman of the board of the coal company, refuses to accept the ultimatum of President Lewis as to how these mines, owned by railway union men, shall be operated.

The correspondence is replete with charges and countercharges. Apparently, there are strong differences of opinion among these organization leaders as to certain bases and practices often referred to as fundamental.

The United Mine Workers have seen fit to publish and broadcast the correspondence to date, undoubtedly with the thought that a final solution will be found in their favor. It will be interesting to observe the reactions upon their mutual cause, but it is difficult to see where these fulminations can have a beneficial effect upon Public Opinion, which after all is the court of last appeal for such controversies.

Mighty Machines at Conneaut Harbor

Eight Modern Ore Unloaders Discharge 70,000 Tons of Ore in Twenty-two Hours

CONNEAUT Harbor now leads the world in tonnage of iron ore received and unloaded on the most modern ore-dock. Pictured below across the double page is shown the Pittsburgh & Conneaut Dock Company's lower lake terminal, where upper Minnesota and Michigan ores meet the railroads which penetrate the Pittsburgh, Youngstown and Wheeling iron and steel making districts.

Engineered and manufactured by the Wellman-Seaver-Morgan Company of Cleveland, unloaders of identical type have created history in the rapid dispatch of lake vessels.

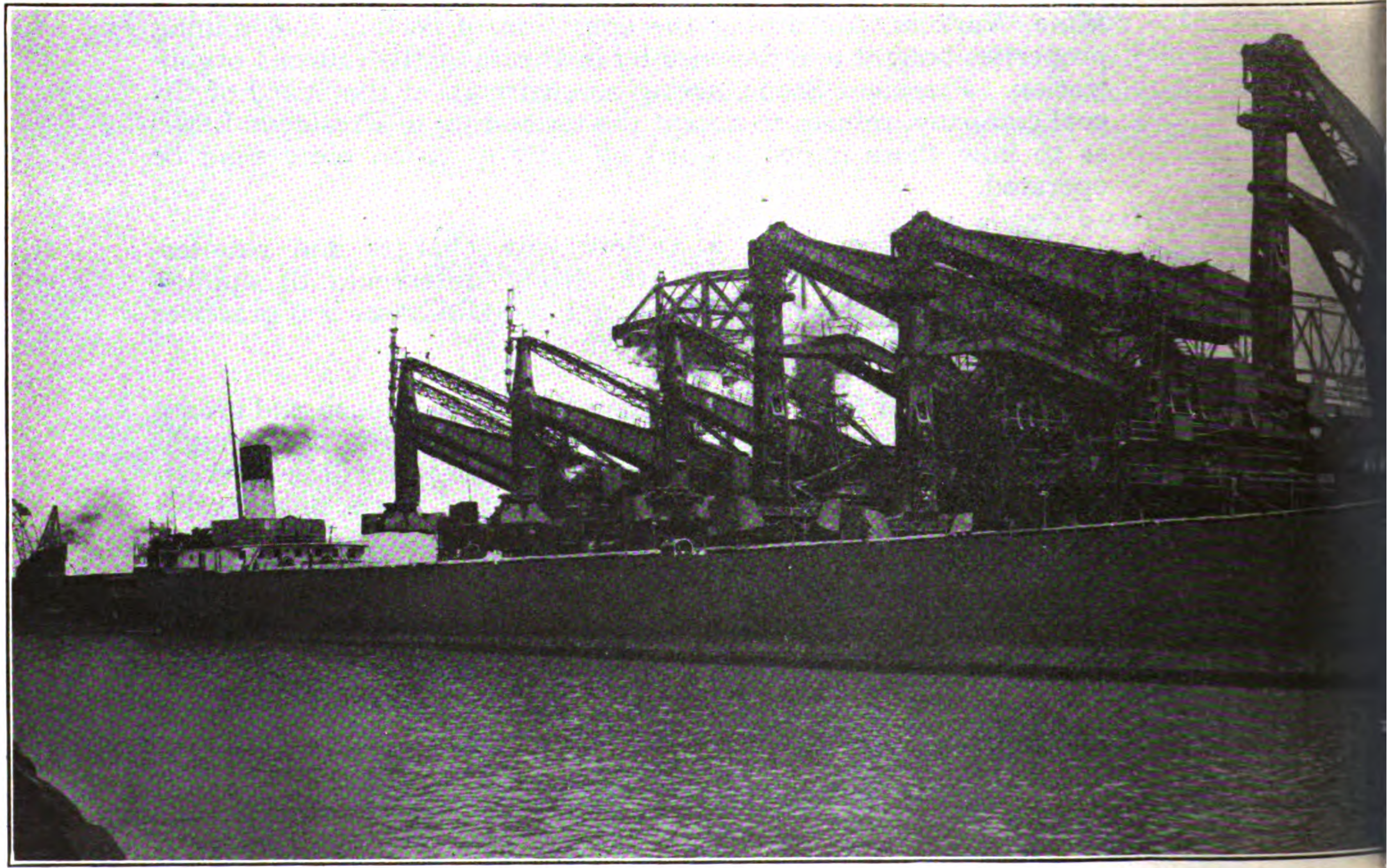
Seven such unloaders transferred in less than four hours 10,600 tons of iron ore from the steamship J. A. Campbell to railroad cars at Conneaut Harbor. The same equipment discharged the cargo of 11,000 tons from the W. P. Palmer in two hours and 58 minutes. Three men formed the operating crew for each machine.

Similar machines used as coal unloaders handle enormous tonnages of coal at the docks of the Canadian Pacific Railway at Fort William, Canada.

Previous to 1910 this type unloader was operated hydraulically. Four such machines shown at the left, contracted for in 1898, were the originals of this type unloading equipment. They were of 10-ton bucket capacity. This dock was electrified in 1910, and later installations have been electrically operated, 220 volts d.c. being employed.

The two unloaders shown at the extreme right in operation in two of the forward hatches of the lake steamship Percival Roberts, Jr., were put in operation on July 1, 1924. The contract for building these machines was awarded on January 1, and completing the work in six months is regarded as establishing a record.

Each unloader is a unit and consists of a main framework mounted on trucks which travel along runway rails located at the rear. The main framework extends back to the rear runway over a temporary storage pile. Between the front and rear runways space is provided for railroad tracks, where ore-carrying cars are placed under the machines and loaded with ore for transportation to the furnace plants. The girders of the main framework form a support for the runway rails on which a trolley travels. This trolley supports a balanced walking beam, from the outer end of which a stiff bucket leg hangs, as shown in the



This photograph taken on July 14, 1924, is a view showing the ore dock of the Pittsburgh & Conneaut Dock Company, Conne Harbor, Ohio. Nine Wellman-Seaver-Morgan Company's ore unloaders complete the equipment which is the largest ore unloading pl in the World. The four machines at the left were the first of this type to be constructed, the contract being let as early as 1898. Th machines are of 10 tons capacity each and are hydraulically operated. The first of these electrical machines was installed in 1910 a the two on the extreme right have just recently been put into commission. It is to be noted that a new record has been establishe illustration. The bucket is at the lower end of this leg and is operated by machinery located on the walking beam. All horizontal movements of the bucket are by means of moving the trolley backward and forward on the girders, vertical movements of the bucket being accomplished by the operation of the walking beam. The forward portion of the beam being out of balance, the bucket descends by gravity as soon as the brakes of the hoisting mechanism are released. The hoisting mechanism is located in an inclosed house at the rear end of the walking beam.

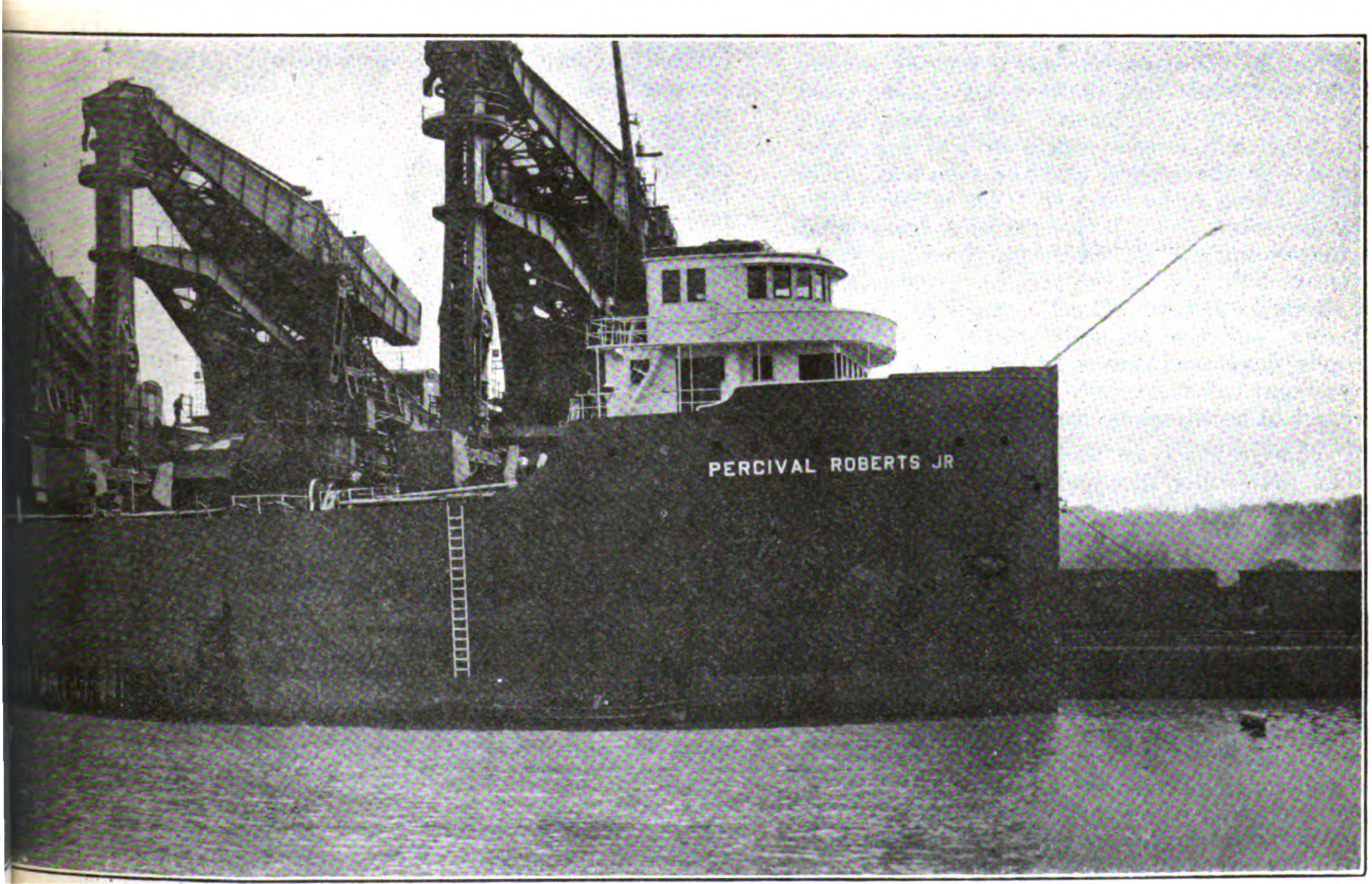
A receiving hopper mounted at the forward end of the main framework and between the main girders is provided for receiving ore discharged from the bucket. The hopper holds about three full bucket loads, and is intended to act as a balancing point for the ore between the bucket and the cars or storage, as the case may be. The hopper is equipped with outlet gates, the contents being discharged as required into a larry which runs on an auxiliary track suspended from the upper side of the main girders. The larries moved to a point where their contents may be discharged into cars or into a temporary storage pile.

Machines of the type illustrated have been built in capacities of 10 and 17 tons in the bucket shells. The speeds of electrically operated units are regulated so as to operate through a complete cycle in about 50 sec. Eight machines of this type, having a capacity of 15 tons each, unloaded seven boats of 70,000 tons total capacity in 22 hrs. Four machines working in boats of 13,000 tons capacity are said to have unloaded these cargoes in about 3 hr. 25 min. Unloading costs ranging from 2½ to 4½ cents per ton are claimed, which cost includes superintendence, labor, repairs and materials on the machines as well as cost of power and light.

In operating the machine, the latter is moved opposite one of the hatches of the boat to be unloaded, and the bucket is lowered through the hatch into the ore. After filling the bucket the walking beam hoist mechanism is put in operation and the bucket hoisted out of the boat. At the same time the trolley is traveled back so that the bucket is brought over the main hopper between the girders in the main framework and its contents discharged into this hopper. The bucket is then returned to the boat.

The ore in the main hopper is discharged in turn into the larry, the hopper of which is equipped with scales so that its contents may be weighed and the weight recorded. If railroad cars are not available for immediate shipment, the larry is traveled to a position on the rear cantilever of the machine and its contents discharged into a temporary storage pile. From this pile it is usually reclaimed for shipment or storage by means of a bridge located on the runway at the rear.

Only two operators are required for one machine. One operator whose station is in the bucket leg directly over the bucket shells, controls the raising and lowering of the bucket, travel of the trolley back and forth, and moving the other machine along the dock. The other operator controls from the larry cab.



construction of these last two machines, the contract being awarded January 1, 1924, and the machines were put into operation on 1, 1924, requiring only six months to complete the work, a task never before attempted in the short space of time. Not shown in picture, but of equal importance, is the unloader leg and bucket which works in the hold of these modern freighters. The leg is mounted in the walking beam that it can rotate in a circle allowing the bucket to reach out in every direction. Less than three per of a cargo of ore is left for removal by shovelers.

Present Day Developments in Iron and Steel Industry

Methods Employed in Turbine Drum Manufacture Suggest Making Hollow Ingots

By A. C. BLACKALL*

At recent meetings held by the London Iron and Steel Institute, many subjects of interest have been discussed. Sir William Ellis, in his inaugural address after election as president, dealt with improvements in steel manufacture carried out during the period of nearly 40 years, in which he has been associated with one of the leading steelworks dealing with specially complicated metallurgical problems. The president said that in the early eighties the management of steel works was in the hands of men of great common sense and power of application, but owing to the absence of efficient means of training they were unable to deal with their practical difficulties except by common-sense methods.

The various departments were run by separate engines with long steam mains, very often poorly protected against condensation, so that the efficiency of the various driving engines was very low. Hydraulic pressure of 400 lbs. and sometimes 750 lbs. was largely in use, but likewise produced by very uneconomical engines. Steel hammers up to 50 tons were in use, but four firms had already put down forging presses up to 4,000 tons, and steel shafting for marine work was only just being introduced. Jib cranes, which were very slow and uneconomical in working, were largely in use in the forges, and the overhead crane was only beginning to be adopted. These were often driven by long lines of square shafting from small engines uneconomically served by low pressure steam from a distant boiler, or in the case of machine shops by ropes similarly driven. The Bessemer process was in full swing, and the Seimens-Martin was already being largely developed, but a 30-ton furnace was in those days regarded as of high capacity. Metallurgy as a science had hardly come into existence.

A vast change has been wrought. The Bessemer process has practically disappeared in Great Britain and the Seimens-Martin process reigns supreme, but on a far larger scale, furnaces over 60 tons weight being common practice. Steel-making in electric furnaces has also been introduced, and, owing to the absence of coke in the process, steel of exceptional purity is being produced, and a very accurate analysis is obtainable owing to complete control during melting being possible.

Forging plant has developed to an enormous extent. Ingots of over 100 tons weight are required both for gun forgings and for large marine shafting, and it is obvious that it is only the introduction of hydraulic presses for forging purposes which has rendered this class of production possible. The use of lighter presses, 2,000, 1,000 and 500 tons for varying classes of forging work has also become common practice, and steam hammers have practically disappeared except for use in the smith's shop and for the production of lighter classes of forgings. The introduction of electric driving and high-pressure steam are the two elements which have revolutionized steelworks equipment and introduced economies more than any other features except perhaps improved education. While great progress has been made in the manufacture of ingots of heavy tonnage since the days when they were made in composition moulds, there is still a great deal to do before uniformly satisfactory ingots can be produced. Let it be assumed that the quality of the steel as it leaves the furnace is what is required, and that the melting has been carried out satisfactorily and the requisite analysis arrived at. The troubles which exist arise mainly from the behavior of the steel after it is run into the mould. The greater the diameter of the ingot the longer is the time of cooling, and consequently the greater is the difference in structure between the top and bottom and the outside and center of the ingot. The Whitworth fluid pressing system introduced many years ago; the use of cast iron molds instead of compo lined, the introduction of the Harmet process, were all endeavors to overcome the effect of the natural rate of cooling, and were attempts to arrest the steel in its uniform quality when it arrived in the mould. Owing to the difference in specific gravity of the different elements in a steel ingot, principally carbon, phoshorus and sulphur, the longer fluidity continues the greater is the opportunity for these elements to rearrange themselves to their own liking. This results in segregation and various occlusions, and in view of the nature of the work for which ingots of this nature are required the greatest possible uniformity in structure and physical properties is essential. The metallurgist who can successfully overcome the inherent difficulties of producing ingots of large weight and uniform structure will have indeed done a great service to the steel industry.

When the building of the Lusitania and the Carmania were contracted for, both turbine driven, the manufacture of turbine drums constituted a mechanical difficulty which was dealt with by welding. As it was, however, desirable to introduce some better method the patent rights of a hollow rolling process exhibited at the Dusseldorf Exhibition were obtained. A large rolling mill was then designed and also a powerful punching press, which enabled the builders to commence with a solid ingot from which the center was punched or, in the case of larger work, bored. Thereafter it was rolled to the requisite diameter in the hollow rolling mill. On the introduction of geared turbines this method was again of special use, as most of the large gear rims for the different war vessels and passenger lines have been made in this way. It is felt that a greater uniformity of structure is obtained over the periphery where the teeth have to be diagonally cut in rims produced by hollow rolling. The reason for mentioning this particular industry is that for many purposes development in the way of producing hollow ingots would be of great service, as it would to a great extent do away with the undesirable center portion of the ingots of large diameter, which has now to be removed by punching or boring. It is also not improbable that for plates of large size, where uniformity of quality is necessary, a hollow ingot cut and flattened out might give better results than if rolled from a solid ingot of very heavy weight.

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*London, England

J. P. Bedson discussed the continuous rolling mill, and said the considerations entering into this question were those of balancing low operatings costs and high yield against somewhat heavy initial cost. With a combination of the continuous mill small plants could be designed which would give increases in output with considerable saving in labor for mills where anything from 500 to 1,000 tons per week were required of the usual standard small sized rods and bars.

Dr. Arne Westgren and Gosta Phragmen dealt with X-Ray studies of the crystal structure of steel—a comparatively new method from which important results are being obtained.

The institute has presented its Bessemer medal to Professor Albert Sauveur, the famous American metallurgist.

It has long been recognized that the open hearth steel furnace is from the thermal point of view a very inefficient apparatus. W. Dryssen of New York reminded steelmakers in this country that very little has been done to improve this type of furnace's efficiency, and consequently its fuel consumption remains practically the same today as it was 30 years ago. Attention has been recently directed to making a reduction in the cost of steel making by taking steps to utilize the heat losses associated with the operation of the open hearth furnace. This has taken the form of installing waste heat boilers to recover the heat as steam, and a point has been reached today when as much as 27 per cent of the heat in the fuel can be recovered in this manner. Even in a well-designed producer gas open-hearth furnace the heat actually used by the bath is only a small percentage of the whole. In the ordinary hot pig-iron process the losses are at least 92 per cent, and in the cold pig-iron process never less than 85 per cent. This constitutes a very serious waste of fuel and makes out a strong case for the use of waste heat boilers. Old-fashioned British steel makers are sometimes inclined to look askance at the association of steam-raising with the steel furnace and appear to fear that the logical sequel to developments of this character may be to make the manufacture of steel a kind of by-product of steam-raising plant. This is an extreme view to take, and most of the experts who have given attention to the subject are convinced that there is a good deal to be said for the utilization of waste heat for steam-raising purposes. On the other hand, those who insist that the line of improvement should be to increase the output of steel for a given expenditure of fuel are seeking to raise the efficiency of steel making plants by direct means. There is, however, no good reason why work in both directions should not proceed at the same time and bring about a material reduction in the cost per ton of producing ingots.

Washing of Northwestern Coals

During the past several months a study of the washability of fine sizes of coal on tables, with particular reference to Washington and Alaskan coals, has been conducted by the Department of the Interior, in co-operation with the University of Washington, at the Seattle station of the Bureau of Mines. A coal from a Washington mine, presenting unusual washing difficulties, has been studied in considerable detail, using a particular commercial-size table. Float-and-sink tests of zonal products, supplemented by screen-sizing tests and chemical analyses, have given valuable information as to the workings of a coal table. This work is not yet completed but several conclusions of general application to any tabling operation may be drawn from the work to date.

There is a definite relationship between the tonnage of feed to a coal table and the maximum size of particles in the feed which will separate well on the table. The coarser the feed to the table, the greater must be the tonnage fed to obtain a good separation. A certain depth of material is required on the table to permit good stratification, this depth varying with the coarseness of the feed. On the other hand, there is an upper limit to the depth of material that can be separated on the table. These two factors will determine the maximum size of coal that can be handled by a table.

The table used in the Bureau of Mines tests has a remarkable sizing action on all material that is properly stratified, that is, on all material that is not too coarse to stratify in the depth of coal on the table, and at the same time is not sufficiently fine to slime. The coarsest particles of any given specific gravity are discharged from the table first, and the finer the material the farther it will be carried out on the table before it is discharged. Materials of all specific gravities follow this same law. The result of this sizing action of the table is to make it impossible to obtain a clean separation between materials near in specific gravity when using an unsized feed. On the other hand, a separation using a classified feed will be favored by this action of the table.

The efficiency of the washing operation on tables is low when attempting to make a low-ash washed coal, and increases rapidly with higher allowable ash content in the washed coal. The explanation of this fact seems to lie in the fact that the largest proportion of the impurities is near in specific gravity to that of coal. The sizing action of the table previously mentioned causes an overlapping between material of different specific gravities, and the effect on the efficiency of the separation is more pronounced where the proportion is large.

Sampling of Blast Furnace Gases

Somewhat more than a thousand gas samples have been taken from the interior of a commercial blast furnace shaft during the past year by the Department of the Interior engineers, who are making a study of commercial blast furnace practice for the Bureau of Mines. These data have been studied, and a report of the results will be issued at an early date. A similar investigation will be conducted by the Bureau of Mines at another commercial blast furnace in the future.

Flow of Gas or Air in Pipes

By Using the Formulae Given Both High and Low Pressure Flows May Be Estimated

By FRANKLIN H. SMITH*

IN considering the flow of gases (air, etc.), in piping, a distinction must be made as between low pressure flow and high pressure flow. When the difference between the initial pressure and the terminal pressure is small (that is a few inches of water) the variation in density (due to increased or decreased volume resulting from a decreased or increased pressure) may be neglected without great error and the hydraulic formula is applicable. The hydraulic formula referred to has the form $Q = .7854d^2v$, in which the velocity "v" is determined from the pressure, coefficient of friction, etc.

When the difference between the initial pressure and terminal pressure is great (that is many inches of water or pounds) the variation in density (due to increased or decreased volume resulting from the decrease in pressure along the line) must be considered and the hydraulic formula must be modified to suit.

The writer recommends that the gas formulae subsequently given be used for both low pressure and high pressure flow as giving, with a proper coefficient of friction (which should be used in any case) more correct results.

When a gas flows along a pipe, there is necessarily a fall of pressure due to the resistance of the pipe and consequently the volume and velocity of the gas increases, going along the pipe in the direction of travel. The effect of the resistance is to create eddying motions which, as they subside, give back to the gas the heat equivalent of the work expended in producing them. The result is that, apart from conduction through the walls of the pipe the flow is iso-thermal (that is constant temperature). In the following the expansion will be considered iso-thermal; in other words "T" is taken as constant. Assuming "T" as constant is on the safe side in the majority of cases because any reduction in temperature of the gas from external sources will assist the flow due to a decrease in volume; conversely, any increase in temperature of the gas from external sources will retard the flow, but this is an unusual condition.

(1)—(a) If the pipe is horizontal, the effect of gravity and barometric pressure in the upward or downward flow is zero; if the pipe is approximately horizontal, in contradistinction to a cross country installation having great rises and falls, the effect of gravity and barometric pressure on the upward flow or downward flow is approximately zero.

(b) The resistance of ells, tees, valves, etc., must be reduced to equivalent of pipe for which see Nat. T. Co. Hd. Bk. 1913 Ed., p. 324 and other authorities.

(c) The relation between the capacity as determined by Unwin and other formulae is as follows (from Nat. T. Co. Hd. Bk. p. 323, 1913 Ed.):

	Relative Capacity
Cox	0.98
Unwin	1.00
Oliphant	1.05
Pittsburgh	1.08
Rix	1.09
Towl	1.13

The Nat. T. Co. Hd. Bk. 1913 Ed., p. 323, states that the Oliphant & Pittsburgh formulae are most generally accepted; therefore, since the Unwin formula gives somewhat less capacity than the Oliphant or Pittsburgh formula, it is on the safe side.

(d) The quantity of gas discharged varies as the square root of the difference of the squares of the initial and final pressures. Nat. T. Co. Hd. Bk. 1913 Ed., p. 323.

(2) D = dia. in feet.
C = coefficient of friction for gases.

$$= .0044\left(1 + \frac{1}{7D}\right) = .0044 + \frac{.0044}{7D}$$

Diameter	C.
6 in.	.0057
12 "	.0050
18 "	.0048
24 "	.0047
30 "	.0046
36 "	.0046
42 "	.0046
48 "	.0046
60 "	.0045

Unwin gives another coefficient for air and gases of other densities which is less than as given above. However, since the above coefficient "C" gives a smaller flow, it may be safely used for the flow of air and all gases for piping for industrial plants.

(3)—m = Hydraulic mean radius
$= \frac{D}{4}$ for pipes of circular section
D = Dia. in ft.
$E = \log \frac{P_1}{P_2}$
g = Acceleration due to gravity
$= 32.2$
R = Gas constant
$= \frac{53}{S}$ (53 = gas constant for air)
S = Specific gravity of the gas compared to air
T = Absolute Temp. F.° (= 461 + Temp. F.°)
P_1 = Greater (initial) pressure lbs. per sq. ft. absolute
P_2 = Lesser (terminal) pressure lbs. per sq. ft. absolute
C = Coefficient of friction (see item "2")
L = Length of pipe in feet
V_1 = Initial velocity in the pipe, ft. per sec.
V_2 = Terminal velocity in the pipe, ft. per sec.
Q = Flow, cu. ft. per sec., at "T"
K = Weight, lbs. per cu. ft., at "T"
= (S) × (wgt. of air at "T")

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*National Tube Company, Pittsburgh, Pa.

W = Weight of gas (or air) flowing in pounds per second = QK

Note: For a steady flow the same weight must pass every given point in any given time.

$$V_1 = \sqrt{\frac{gRT(P_1^2 - P_2^2)}{P_1^2 (4Lc \div D + E)}}$$

$$= \frac{41.3}{P_1} \sqrt{\frac{T (P_1^2 - P_2^2)}{S (4Lc \div D + E)}}$$

(General formula for circular pipes.)

$$= \sqrt{\frac{gRTD^2 (P_1^2 - P_2^2)}{P_1^2 [.0025\ L\ (7D + 1) + D^2E]}}$$

$$= \frac{41.3}{P_1} \sqrt{\frac{TD^2 (P_1^2 - P_2^2)}{S [.0025\ L\ (7D + 1) + D^2E]}}$$

(General formula for circular pipe modified for coefficient of friction "C"—see item "2". Also see "V_1".

$$W = \frac{.7854\ D^2V_1P_1}{RT} = \frac{.0148\ D^2V_1P_1S}{T}$$

$$= \frac{.7854\ D^2V_2P_2}{RT} = \frac{.0148\ D^2V_2P_2S}{T}$$

Since W = QK

$$Q = \frac{W}{K}$$

$$= \frac{.7854D^2V_1P_1}{KRT} = \frac{.0148D^2V_1P_1S}{KT}$$

$$= \frac{.7854D^2V_2P_2}{KRT} = \frac{.0148D^2V_2P_2S}{KT}$$

From which

$$V_1 = \frac{QKRT}{.7854D^2P_1} = \frac{QKT}{.0148D^2P_1S} = \frac{V_2P_2}{P_1}$$

(See also V_1 above.)

$$V_2 = \frac{QKRT}{.7854D^2P_2} = \frac{QKT}{.0148D^2P_1S} = \frac{V_1P_1}{P_2}$$

Equating the two values of "V_1" to clear as nearly as possible for "D" we get:

$$\frac{QKRT}{.7854D^2P_1} = \sqrt{\frac{gRTD^2 (P_1^2 - P_2^2)}{P_1^2[.0025L\ (7D + 1) + D^2E]}}$$

$$\frac{Q^2K^2T}{.374S(P_1^2 - P_2^2} = \frac{D^6}{.0025L(7D+1)+D^2E}$$

This is the equation to be used to determine "D" which must be found by trial and error.

(4) Solving the general formula above we get:

$$P_2 = P_1 \sqrt{1 - \frac{SV_1^2[.0025L\ (7D+1) + D^2E]}{1706.6TD^2}}$$

From which

$$P_1 = \frac{P^2}{\sqrt{1 - \frac{SV_1^2[.0025L\ (7D+1) + D^2E]}{1706.6TD^2}}}$$

(5) Example—To find "D" knowing—

P_1 = 3124.8 lb. (=14.7+7×144) for 7 lb. per sq. in., gage.

P_2 = 2179.3 lb. (=14.7+.434×144) for 12 in. of water, gage.

L = 10400 ft.

Q = 231 cu. ft. per sec. (for 20,000,000 cu. ft. per 24 hrs.)

S = .321

K = .0244 (=.321×.076)

T = 521(=461+60)

From which

$$E = \log \frac{P_1}{P_2} = \log \frac{3124.8}{2179.3} = \log 1.43 = .15$$

$$P_1^2 = 3124.8^2 = 9{,}764{,}375$$
$$P_2^2 = 2197.3^2 = 4{,}749{,}348$$

$$P_1^2 - P_2^2 = \quad 5{,}015{,}027$$
$$Q^2 = 231^2 = 53361$$

$$\frac{Q^2K^2T}{.374S(P_1^2 - P_2^2)} = \frac{53361 \times .0244^2 \times 521}{.374 \times .321 \times 5015027}$$

$$= .02749 \text{ say } .0275$$

$$.0275 \text{ (should) } = \frac{D^6}{.0025L(70+1)+D^2E}$$

$$= \frac{D^6}{26(7D+1)+.15D^2}$$

Try 1.39 ft. dia. (=16½ in. dia., abt) and substitute in the above:

$$\frac{7.212}{26(9.73+1)+.15\times 1.93} = .0258$$

Try 1.42 ft. dia. (= 17 in. dia. abt.)

$$\frac{8.2}{26(9.94+1)+.15\times 2.02} = .0288$$

The diameter lies between 16½ in. and 17 in. but is nearer 17 in. than 16½ in., 17 in. will be chosen, particularly since it is slightly larger rather than slightly smaller.

For a check on the foregoing see the following.

To check "D" its value of 1.42 will be substituted in the velocity formula (item "3") and then the velocity thus obtained in the formula for "Q" (item "3").

$$V_1 = \frac{41.3}{3124.8} \sqrt{\frac{521 \times 2.02 \times 5015027}{.321[(26 \times 10.94) + (2.02 \times .15)]}}$$

= 100.4 ft. per sec. initial velocity

$$Q = \frac{.0148 \times 2.02 \times 100.4 \times 3124.8 \times .321}{.0244 \times 521}$$

= 236.9 cu. ft. per sec. (which is close to 231 as given. (This increase is due to using a slightly larger diameter than required.)

$$V_2 = \frac{V_1P_1}{P_2} = \frac{100.4 \times 3124.8}{2179.3}$$

= 144.1 ft. per sec. terminal velocity (corresponding to "P_2")

$$P_2 = 3124.8 \sqrt{1 - \frac{.321 \times 100.4^2\ [26 \times 10.94 + 2.02 \times .15]}{1706.6 \times 521 \times 2.02}}$$

(Continued on Page 451)

SHEET AND TIN PLATE

Electric Scrap Baling

A New German Method of Simplifying Production and Meeting Competition

THE scrap iron press pictured below is provided with two stamping punches, of which one moves vertically and the other horizontally. Both are driven by electric motors by means of worm gears and spindles. Overloading of the motors and gears are avoided by using friction clutches.

The material to be baled is collected in a tilting hopper which discharges its content automatically into the trough shaped press. The front wall of this trough is hinged to facilitate the entrance of very bulky scrap. During the baling process the horizontal stamp is lowered first, compressing the material but partially, the pressure and corresponding dendity of the bale being indicated by an ampere meter while its height is shown by a gauge in the operators stand. As soon as the proper height is attained the horizontal stamp is forced forward, compressing the material sideways and causing the particles of scrap to interlace so thoroughly that it forms a parcel which will withstand the rough handling during storing and charging.

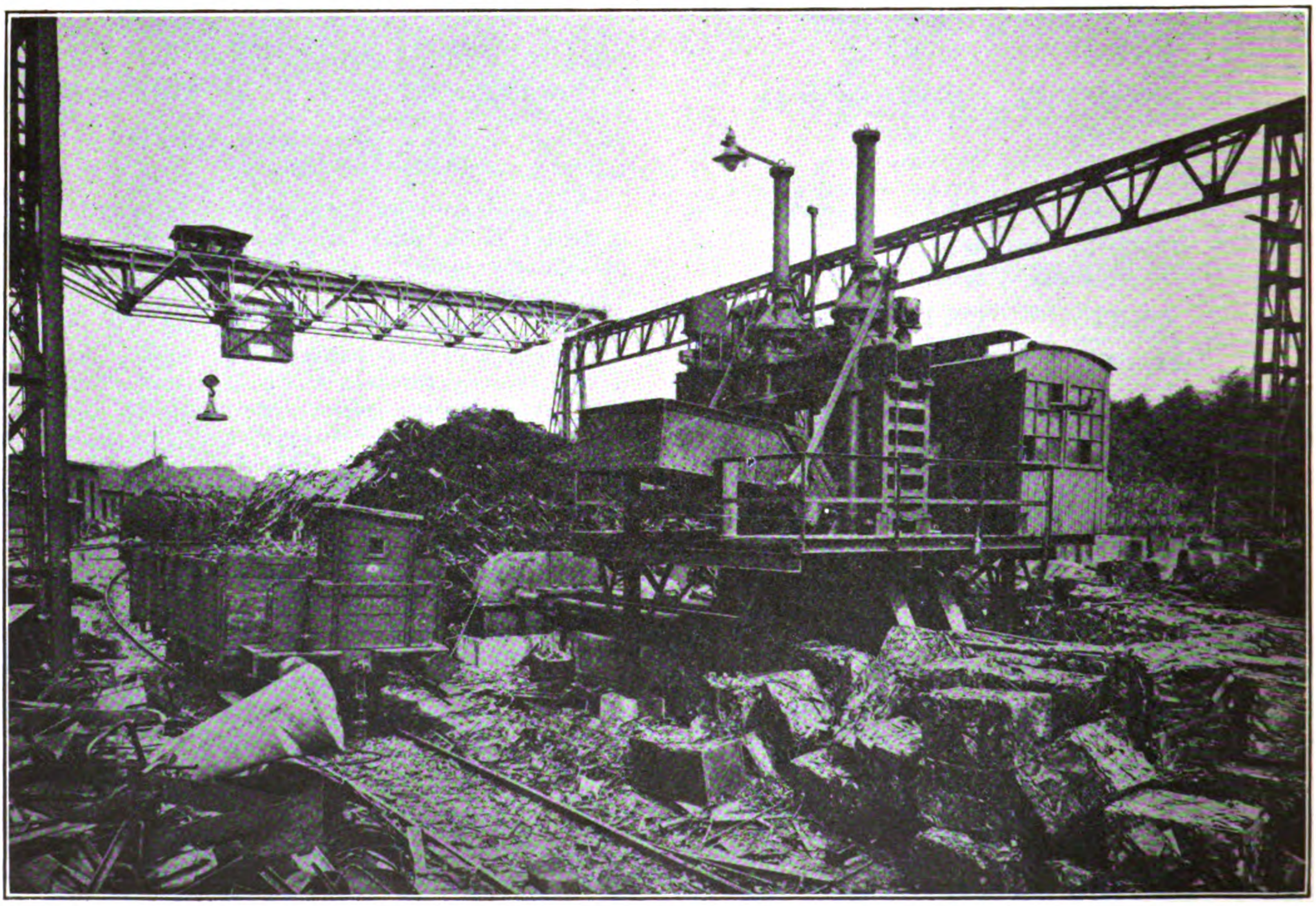
The finished bale is ejected from the press through a trap door by pushing the horizontal stamp through its full stroke.

It is advisable to discharge the bale immediately into the charging ladle.

The following weights of parcel are recommended:

200 to 700 lbs. for small presses
800 to 1,000 lbs. for medium presses
1,000 to 2,000 lbs. for large presses

The output of the press depends on the material used and the size of the parcel and varies between 20 and 70 tons per 8-hour shift.



Exceptional view of a large scrap-baler at work in Germany. This machine makes possible very great economies in sheet mill practice.

The Tin Situation

In discussing the tin situation the National Bank of Commerce states in the September issue of Commerce Monthly that the United States now consumes around 60 per cent of the world output of tin. Continuing the bank says:

"The heavy tin consumption in the United States results from its position as the greatest manufacturer of tinplate, a rank gained within recent years. According to present estimates, the tinplate output of the United States in 1923 was larger than the total world output in 1910. This country has been a net exporter of tinplate since 1911. While net exports have grown from 106,000,000 pounds in that year to 579,000,000 pounds in 1918, and 256,000,000 pounds in 1923, the home market is the chief reliance of the industry."

Referring to world production of the raw material the bank adds:

"Although tin is the rarest of common metals of commerce and occurs in paying quantities in but few widely separated localities, increase in production has thus far more than kept pace with increased world requirements. In 1903 the world output was 93,893 tons, while in 1923 it amounted to approximately 125,800 tons, or an increase of about 35 per cent. However, world production for various reasons has declined considerably from the high point of 133,565 tons produced in 1913. Reduced production in recent years has been caused largely by accumulations of stocks at mines and refineries during and following the war, unsatisfactory price conditions and the gradual exhaustion of richer workings.

"Deliveries of tin constitute the best available, though only an approximate, measure of world consumption. In the pre-war years 1910-14 consumption, estimated on this basis, ranged between 107,000 and 120,000 tons and averaged 112,000. Since the war, consumption has ranged from a low of only 75,000 tons in 1921 to 130,000 tons, a high record, in 1923. While 1923 consumption was considerably in excess of primary production, the substantial available carryover more than offset this difference and the average of 1923 prices, while much better than in 1921 or 1922, was still on a level with average prices before the war.

"While other countries have not expanded consumption of tin above pre-war ratio, as has the United States, the amounts used elsewhere have increased, since the post-war slump, to a level approaching that of pre-war years.

"Despite the outstanding position of the United States as a user of tin, the principal market for trading is London, and the London price leads those of markets elsewhere. Demand for tin in the United States is of course a most important factor in determining the London price. Thus the heavy rate of operation in the American tinplate industry in 1923 and the early months of 1924 was reflected in the upward swing of tin prices, while a prompt and drastic decline in prices followed the let-down in the tinplate industry.

"Summarizing the present situation, world consumption, since the depression of 1921, has somewhat exceeded the pre-war level. Production is still below 1913 output. The older producing areas of the British Empire have felt the decline in production most strongly, while newer low cost areas have tended to increase their output. Even in the older districts, however, many producers have succeeded in reducing costs to within measurable distance of the pre-war figures. Meanwhile, with the clearing away of excess stocks and the growth of demand for the goods into which it goes, the tin industry is working into a sound position."

Electrochemists Meet at Detroit Oct. 2-3-4

An unusual amount of interest has been aroused in the forthcoming meeting of the American Electrochemical Society, to be held at the Hotel Tuller, Detroit, Mich., October 2, 3 and 4. The subjects covered by the program have a wide commercial bearing.

Two sessions will be devoted to the subject of "Corrosion," a subject of interest not only to the electrochemist, but to engineers in every field of activity. Contributions to this live subject have been received from all parts of the world and the sessions promise to be very well attended.

Detroit is the heart of the automobile industry of this country and it is very fitting for the Society to have at this time an open forum on the topic, "Industrial Electric Heating," in which field the automobile industry has made such remarkable strides. Prof. C. F. Hirshfeld, of the Detroit Edison Company, is responsible for an admirable program on this topic of electric heating.

There will also be sessions on Refractories for Electric Furnaces and the Physical Chemistry of Electrodeposition.

Two round table discussions have been arranged: one on "Electric Furnace Cast Iron," in charge of G. K. Elliott, of the Lunkenheimer Company, Cincinnati, and the other, on "Control Methods in Electrodeposition," in charge of Prof. O. P. Watts, of the University of Wisconsin, and Dr. William Blum, of the Bureau of Standards.

Mr. Alex Dow, well known throughout the country as one of the foremost central station engineers, will address members and guests on Friday evening, his subject being, "Central Station Design and Superpower."

Aside from the technical and scientific program, the entertainment committee has spared no effort in making the visit of the Society members a memorable one. For Wednesday evening, a "get-together" fish, frog and chicken dinner at the famous Eastwood Inn has been arranged. Other entertainment features include a smoker at Hotel Tuller Roof Garden, automobile trips and theater party for the ladies, and visits to a number of the large automobile plants.

Flow of Gas

(Continued from page 449)

$= 3124.8 \times .6975$

$= 2179.5$ absolute terminal pressure, lbs. per sq. ft.

$\frac{2179.5}{144} = 15.135$ lb. per sq. in., absolute

$15.135 - 14.7 = .435$ lb. per sq. in. gage (= 12 in. water column, which checks the given value).

Chromium—Its Uses and Its Alloys

Due to Its Valuable Properties, Chromium Is Extensively Used in the Steel Industry for the Manufacture of Alloy Steels and Heat and Corrosion Resisting Alloys

By DR. WALTER M. MITCHELL*

PART II

THE chief interest of chromium to the metallurgist is its use in the steel industry for the manufacture of alloy steels and heat and corrosion resisting alloys. The attention of the steel industry was first definitely drawn to chromium steels by R. A., now Sir Robert, Hadfield in a long report to the Iron and Steel Institute in 1892. This was the first systematic investigation of these steels and showed many of their remarkable properties. It is interesting to gain from this report a glimpse of the metallurgy of 30 years ago, when we read, "Judging from the results of the tests given in this paper it is probable that chromium steel has an important future before it." He adds, "The writer cannot but think that the special question of steel alloys or combinations will be found to possess considerable practical importance to the world at large, and perhaps be the means of enabling our civil and mechanical engineers to design and construct works of a magnitude at present not possible. * * * When it is borne in mind through how many difficulties the metal known as carbon steel has had to struggle, and for how long a time it has had to undergo trial and examination, it is not surprising that the introduction of special combinations, such as manganese, nickel, and chromium steel should take place but slowly." And this was only 30 years ago! How rapidly has metallurgy and the use of special steels advanced in that short time; and what may we expect in the next 30 years?

Apparently the earliest experiments with reference to the addition of chromium to iron and steel were made by Faraday and Stodart* in 1920. They believed that as chromium was a hard metal its addition to iron or steel would confer increased hardness, and that it might thus take the place of carbon. This we now know to be incorrect for, while chromium will increase the hardness of iron, it will not take the place of carbon in conferring hardening properties.

In 1923, Berthier† published an account of his experiments which had been inspired by the work of Faraday and Stodart. Berthier described the manufacture and tests of steels containing 1 per cent and 1½ per cent chromium from which knives and razors, reported as being of good quality, were made. Berthier's work is of considerable interest because he succeeded in making ferro chromium alloys containing 17 per cent chromium, and some special samples containing as high as 60 per cent chromium. He mentions the care he had used in the preparation of this alloy, not because he believed that it had any special value in itself, but because he believed that it would be found useful as a means of introducing chromium into steel. He also noted the great hardness, brittleness, and infusibility of the ferro chromium alloys, as well as their resistance to the action of strong acids.

According to Hadfield, it is probably to Baur of New York that credit is due for the first commercial production of chromium steel. In 1865 Baur took out American patents, claiming "a steel greatly improved, toughened, and hardened by the addition of chromium, and also claiming to be the first to establish the fact that chromium can be used practically in making steel." In 1869 Baur patented further improvements, and some years later a method of making the ferro chromium to be used. His process was carried on by the Chrome Steel Company, Brooklyn, N. Y., who exhibited numerous samples of chromium steel at the Centennial Exhibition at Philadelphia in 1876. This company, records of which seem to have disappeared, produced laminated plates for burglar proof safes, bars for jails, etc., in addition to the regular chromium steel for cutting tools. In Baur's earlier work he claimed to use chromium as a steel making element, and "that the metal derived its steely qualities solely from the metallic chromium present and not from carbon." This we know to be incorrect, and that chromium does not impart any so-called "steely" qualities; that is, of becoming hard if suddenly cooled. But it was not until considerably later, in 1876, that Baur realized that the direct alloying of the chromium ore with the iron or steel under treatment was so uncertain as to render the product of little value, and

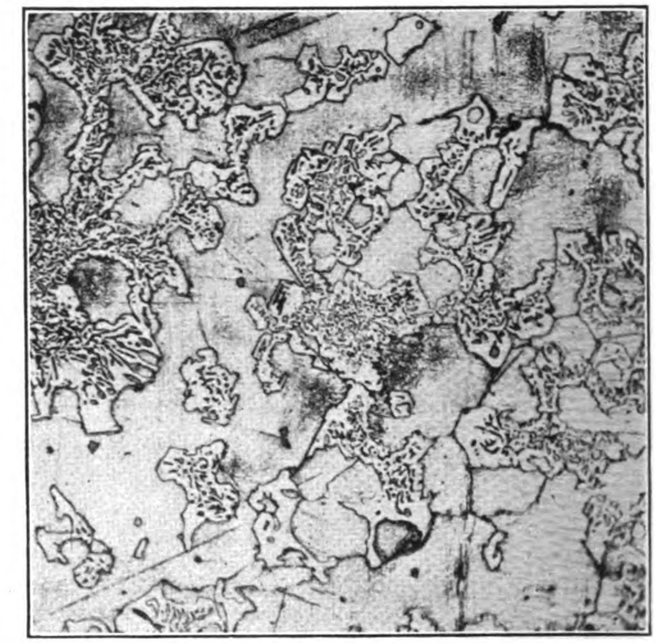


FIG. 3—Maximum 2 per cent carbon ferrochromium. Lace-like patches of carbides are to be noted. 100 ×. Lightly etched with 1-1 HCl. (Reduced ¼.)

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*Phil. Trans. 1822, 253.

†Annales de Chemie. 17, 55.

that the chromium must be introduced as a ferro-alloy in order to insure a reliable product. As this had been announced some 55 years previously by Berthier, it is rather surprising that Baur should have overlooked it. Soon after this chromium steel was made in France by Brustlein, and later in Germany and elsewhere, whereupon it became a common article of commerce, although somewhat limited in use.

Ferrochromium.

The first step necessary for the successful production of chromium steel was therefore the preparation of a reliable and uniform ferrochromium, or "ferrochrome." Berthier realized this, and Baur had no success until he had profited by his own or Berthier's experience and produced the necessary alloy. Ferrochromium was originally produced by both the crucible and the blast furnace processes. The crucible process was decidedly expensive, and hence was confined to turning out high percentage alloys. Baur, in 1869, produced ferrochromium varying from 20 to 45 per cent by mixing chrome ore from the serpentine rocks near Hoboken and New Haven with 6 to 8 per cent of charcoal and a flux, the mixture being fused at a high temperature in graphite crucibles. In 1875 Kern of St. Petersburg is stated to have produced a 74 per cent ferrochromium by fusing in a crucible chromite from the Urals with charcoal.

The manufacture of ferrochromium in the blast furnace is a troublesome process because of the difficulty of reducing chromium from its oxides except at very high temperatures. This requires a very hot blast with high pressure and a heavy consumption of fuel, over three tons being necessary for each ton of alloy produced. (In which connection it is to be recalled that the fuel consumption of the blast furnace in the manufacture of pig iron is less than one ton for each ton of pig produced.) With the blast furnace the practical limit of chromium content was found not greater than 40 per cent, whereas something like 65 per cent was theoretically obtainable from the richness of the ore. Hadfield remarks on the now well known quality of chromium in raising the limit of carbon which will be retained in solution, this being greater than in the case of spiegel or ferromanganese, and running as high as 12 per cent in some cases in a 65 per cent ferrochromium. The carbon is always present in the combined form as a more or less complicated double carbide of iron and chromium. Hadfield tried in various ways to produce graphitic carbon in ferrochromium, but was always unsuccessful. Doubtless this is where some of the fuel required in the blast furnace found its ultimate resting place. Regarding the affinity of chromium in iron for carbon, more will be said later. It is interesting to note, however, in passing, that this characteristic chemical affinity led to the wrecking of a company which commenced the manufacture of pig iron some years ago in Tasmania. This company had valuable ore possessions—over half a million tons of brown hematite lay in sight on the surface, to say nothing of what might be underneath. Unfortunately for them, as it subsequently turned out, this ore contained about 3 per cent chromic oxide. Owing to the propensity of chromium for turning all the carbon into the combined form, the only pig that this company could produce was a hard white iron, which was of little use as foundry iron, could not be puddled into wrought iron, and could not (at that time) be used for making steel; and as a result the company went bankrupt. Later on, however, this supposed white elephant proved to be most valuable when a certain steel works found that their product was much improved by the addition of this white iron; and that axles made of ordinary carbon steel, which would not stand up under the drop test, would do so successfully when the steel was alloyed with a certain percentage of chromium.

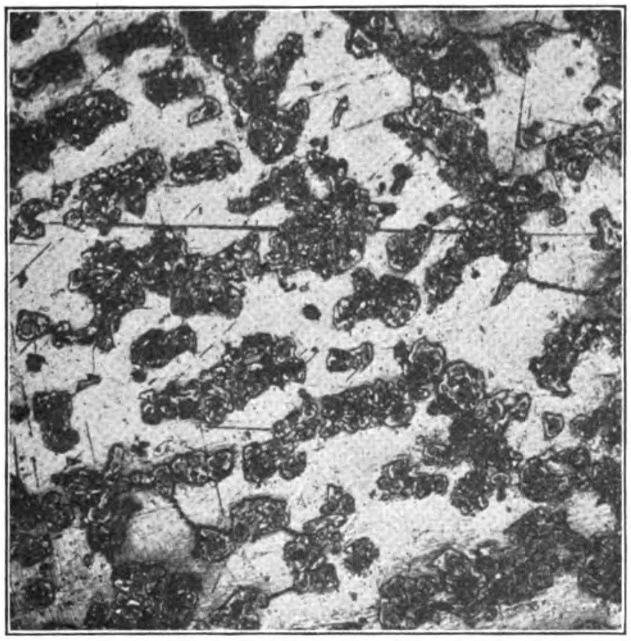


FIG. 4—Maximum 2 per cent carbon ferrochromium. 100 ×. Etched with boiling alkaline potassium permanganate. Carbides darkened.

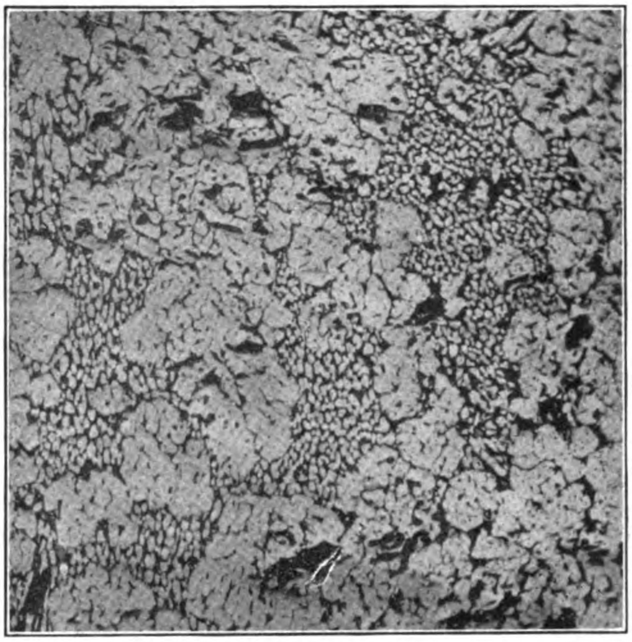


FIG. 5—Maximum 5 per cent carbon ferrochromium showing cellular eutectic structure. 100 ×. Boiling 1-1 HCl.

At present ferrochromium is produced entirely by the electric furnace, and alloys of practically any composition are obtained. The first experiments in this country were conducted by De Chalmont at Spray, N. C., in 1896. A year later, Morehead commenced the commercial production of ferrochromium with the electric furnace at Holcomb Rock, Va. During the Spanish-American War the demand so exceeded the supply that a larger plant was considered advisable, and this was constructed at Kanawha Falls, W. Va., in 1901, and has been in continuous operation since that time. Previously, supplies of the more expensive low carbon grades of ferrochromium had come from Europe, so the manufacture of these alloys was commenced at Niagara Falls in 1907, and a very large proportion of the domestic requirements have since been supplied from that plant.

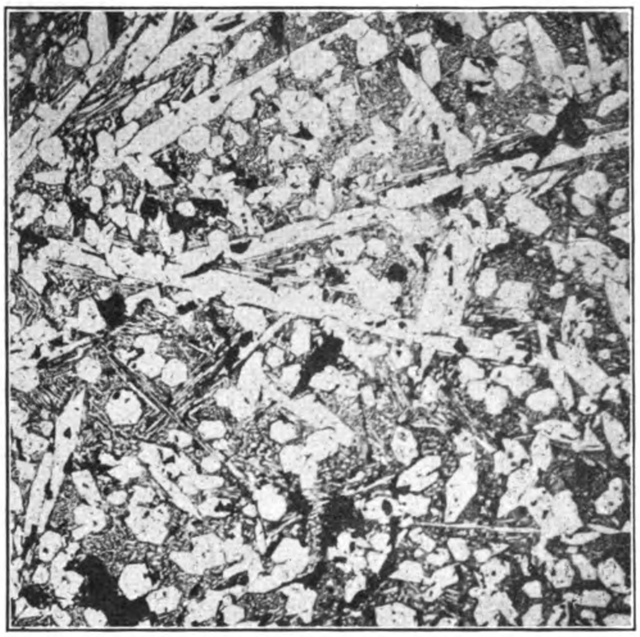


FIG. 6—Maximum 5 per cent carbon ferrochromium. Although this is from the same lot as No. 5, the widely different structure of the carbides indicates different analysis. 100 ×. Boiling 1-1 HCl. (Reduced ¼.)

The process consists in smelting chromite with anthracite coal at a high temperature, which reduces the chromite directly to a 6 to 8 per cent ferrochromium in one operation. Because of the infusibility of chromium carbide and its high carbon content such ferrochromium is not always desirable in steel making; and to further reduce the carbon, which so troubled the earlier metallurgists, the alloy is again smelted in another electric furnace with a slag of chromite, lime and fluorspar. In this way the carbon may be reduced to .50 per cent, or even .25 per cent, the chromium content remaining practically without change. For the manufacture of "stainless iron," very low carbon ferrochromium is necessary, and various reduction processes have been patented for the further elimination of carbon, the metallurgical difficulties of which are considerable, so that the cost of refining greatly increases the price of these alloys over the higher carbon alloys. Through recent developments in these processes we are now able to produce ferrochromium with .10 per cent carbon or less. Similiary, chromium metal of great purity has recently been produced in the electric furnace which, on account of its freedom from carbon and occluded gases, is found to be malleable instead of brittle as previously supposed.

The usual commercial ferrochromium is made in various grades, depending upon the carbon content, running from .20 per cent to about 8 per cent, the chromium content remaining practically constant at 65 to 70 per cent; the balance iron and impurities, of which silicon is the greatest. Owing to the process of manufacture and the nature of the alloy there is decided segregation of carbon, so that, while the average analysis of a lot will run true to its maximum value, individual samples will not do so, and may vary widely. Figs. 3 to 7 are micrographs of a series of ferrochrome showing the variations in structure and constituents depending upon the carbon content. The material is not hard to polish, but it is very hard to grind, and is attacked by only the strongest etching reagents. The high carbon ferrochromes are inclined to be porous or spongy, and are difficult to photograph satisfactorily.

Chromium Steels.

The chief use of chromium in metallurgical processes is for the production of chromium steels, which may be made by either the crucible, electric furnace, or open hearth process. At the temperature of molten steel, metallic chromium is capable of reducing iron oxide, hence depending upon the condition of the slag it may be to a great extent oxidized in the open hearth, particularly during the melting and boiling of the charge. Practically all simple chromium steels are now made by the addition of ferrochromium, as was first established by Berthier, although recently several processes have been patented for the direct production of chromium steel by the addition of chromite with the use of non-carbonaceous reducing agents under a basic slag. In the crucible process the ferrochromium is added with the original charge in the crucible; if in the electric furnace, the addition may be made at any time, but preferably after the charge has melted. In the open hearth, ferrochromium is added just long enough prior to tapping for the alloy to be well melted and mixed through the bath, or otherwise great waste of chromium results. While chromium will, under certain slag conditions, reduce iron ore, it is not as efficient as ferrosilicon or

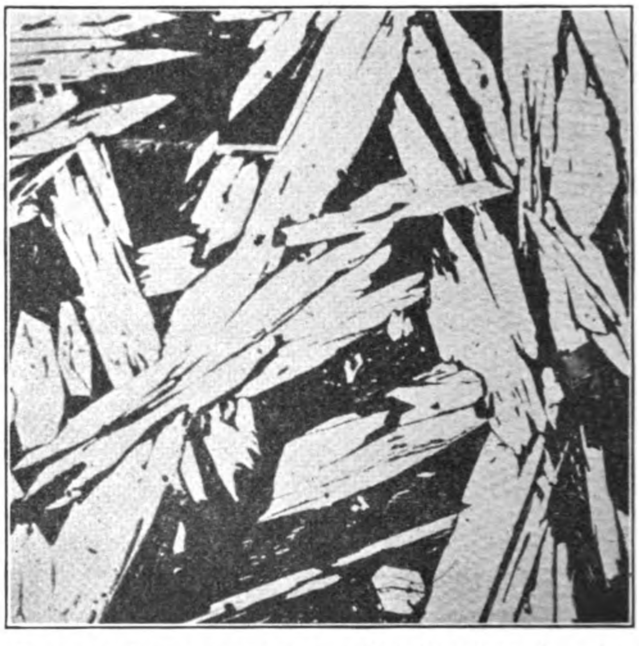


FIG. 7—Maximum 6 per cent carbon ferrochromium, fused and cast into welding rods. Note characteristic "coffin" shaped crystals of carbide. 150 ×. Boiling 1-1 HCl. (Reduced ¼.)

ferromanganese, and is never used as a deoxidizer, but only for its effects as an alloying agent in the finished steels.

The effects produced by the addition of chromium to steel are as follows:

(a) The lowering of the carbon content of the eutectoid, pearlite, so that a steel with lower carbon content containing chromium will be structurally similar to a higher carbon steel.

(b) A retarding effect upon the allotropic transformations of iron, also upon the speed of diffusion of carbon in steel.

(c) The formation, with carbon, of carbides which are not only extremely hard, but which go into solution very slowly, and then only at a high temperature.

It is generally accepted at present that the susceptibility of steel to heat treatment depends upon the formation of a solid solution of iron and carbon when heated above the critical range; and the subsequent dissociation of this solid solution by cooling, at a suitable rate, to the point where the material will have the desired physical properties. The slower the rate of cooling, or the higher the temperature of tempering after quenching, which accomplishes the same purpose, the softer and more ductile the steel.

The effect of the presence of chromium is to retard all these transformations, not only the rate at which the solid solution is formed above the critical stage—this is further retarded by the difficulty with which the carbides are absorbed and diffused—but also the rate at which dissociation takes place when cooling to atmospheric temperatures. Consequently chromium steels are more difficult to render homogeneous, and remain harder, than straight carbon steels when subjected to the same heat treatment. The resultant effect upon the physical properties is increased hardness, finer grain structure, better resistance to shock, and higher tensile strength without corresponding loss in ductility.

(To be continued.)

Maintaining the Quality of Steam Turbine Oil in Service

By C. H. BROMLEY

This is a subject to which a great deal of attention is being given at this time, not only by leading oil companies and turbine builders, but by users as represented by the Prime Movers' Committee of the National Electric Light Association and other similar engineering organizations. The Bureau of Standards has also interested itself in the subject. Of special interest, therefore, is the new Bulletin 11-A of the Richardson-Phenix Division, S. F. Bowser & Company, Incorporated, Fort Wayne, Ind. Although the bulletin does not pretend to be a comprehensive treatise on the maintenance of quality in steam turbine oil in use, it is nevertheless, the most comprehensive piece of literature on the subject today.

Steam turbines are especially severe upon lubricating oils, and a straight mineral oil only can be successfully used. The journal speeds in the bearings of steam turbines, is higher than that met in practically all other machines where the bearing pressure per square inch is comparable. In addition to the very high speeds and comparatively great pressure, the bearings are subjected to high temperatures, due not only to the internal friction of the oil, but to the conduction of heat at high temperature from the high pressure end of the turbine. An appreciation of this is gained when it is realized that total steam temperatures at the throttle in modern power plants are nowadays from 600 to 680 deg. F. Naturally, de to the close clearance between the stationary and revolving elements of the turbine, the oil filled in the bearings must never be broken if the turbine is not to wreck itself.

The rubbing speed of an eight turbine shaft revolving at 1800 rpm. is 3750 ft. per minute—nearly a mile a minute. The rub is only on the oil, and never directly on the bearing metal; that is, the friction developed is always friction. In turbines where the bearing shells are made hollow and cooled by circulating water; water may enter the oil and oiling system if there are any leaks in the water coils of the bearings. The combination of water, air, heat and the rapid circulation of the oil, causes it to oxidize, and readily form emulsion and sludge.

Oxidation is the very serious result to which even pure mineral oils are liable in steam turbine practice, and air and heat are the greatest promoters of oxidation. As a consequence of oxidation, the turbine oil begins to deteriorate, owing to the formation of organic acids caused by oxidation of the unsaturated compounds. This oxidation is greatly accelerated by the presence of small particles of oxidized metals, dirt or dust. The ideal turbine oil would, of course, be one that was nonoxidable, but unfortunately this is not possible under present known commercial means of refining.

Together with the foregoing conditions, the factors tending to rapidly deteriorate the turbine oil are further multiplied because of the service to which steam turbines are put in these days of modern power plant economics. Engineering and power plants today demand the production of a kilowatt at the lowest possible cost, month in and month out. The engineer demands that turbines run at long and continuous periods, at or near their most economical load. This is especially true in the power plants of steel mills and electric public utilities. The number of large turbines increases, owing to the lowering of the water rate by size (of turbines) alone up to certain limits, thus the investment in and the earning power of such machines must be carefully and adequately insured against shutdowns and damage. Power being a basic industry, the production end of the works usually comes to a standstill when power is not available, as when the turbines are shut down.

There must be continuously maintained the widest possible margin of safety with the oil. And this simply cannot be done unless the oil is continuously purified and the water, solids, emulsions, sludge and acid kept from accumulating.

Perhaps a few simple figures will give one a better conception than anything else can of what the oil in the reservoir of a steam turbine is up against in the way of severe service. Take a 30,000 kw. turbine, turning out 15,000,000 kw. hr. per month, month in month out. That means operating at full rated capacity for 70 per cent of every 24-hour day, throughout a month of 30 days. It means that an 1800 rpm. machine, with shaft say 8 in. diameter, would rub the oil in each bearing 5,400,000 ft. per day, or during the total of 21 days in which it was producing the 15,000,000 kw. hr., it would rub the oil in each bearing 113,700,000 ft.—once around the earth every month. The oil in the turbine reservoir, based on a volume of 785 gal., and a turbine oil pump capacity of 225 gal. per minute, would be circulating 8,669 times.

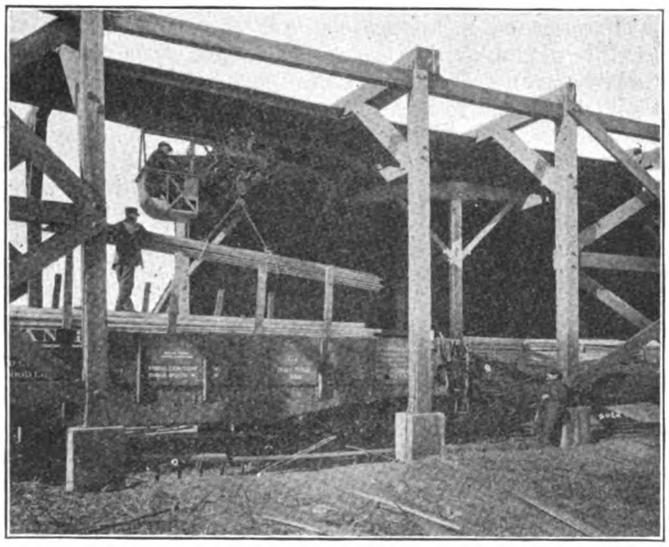
Industrial Transportation

Material Handling Has Been Reduced to a Mathematical Relation Between Laborers Replaced and Cost of Equipment

By RUSSELL B. WILLIAMS

TRANSPORTATION, since the beginnin gof time, has been a problem of major proportions. The ability to move objects, people and thought, from one place to another has, in a large measure, governed the progress of all peoples. Indeed, it can be said that transportation, in the broad sense, is basic in all things industrial and social.

It is only reasonable to believe that many of the lives lost and much of the energy and time expended in the building of the pyramids by the Pharaohs, would have been saved if the rulers of that day had possessed facilities for transportation equal to our present day railroads. We venture to say, the Revolutionary War would have endured for no such period as eight years had George Washington possessed a small fleet of airplanes and a few sets of radio. In similar strain, if some genii could sow broadcast over the face of Europe 10,000,000 automobiles and 10,000,000 telephones — those two mediums for the transportation of people and thought would do more to eliminate future wars than all the leagues, courts and conferences we have ever known or ever will know. Had this country not developed, to their present high state of efficiency, the railroads, telegraph, telephone, roads, etc., in all probability we would not have been a united nation but rather a group of four or five separate commonwealths.



Seven men released for other pursuits by crane manipulating pipe bundles.

So rapid has been our development, however, that we have proved ourselves poor prophets. We plan and work for the future—only to leave behind costly abandonments. Time was when men laid their business foundations, created their commercial enterprises and mapped their future successes on warehouses, river boats and wagon haulage. But the steam railroads came and every plan, every enterprise, every success was altered and revised.

Thereafter, people tacked their faith to the steam propelled utility. But to little avail, for now we have electricity, and electricity has completely revolutionized industrial and social life.

Thus we constantly seek better methods of transportation. The bicycle, once the acme of speed and convenience is now too slow. The tractor has supplanted the wheel-barrow; the elevator the hod; the automobile the chaise. We realize, ever more fully, that given our modern appliances, hand labor and rule of thumb methods are not only obsolete but ruinous. With the result that we trim here and pare there, the application of hand labor to all things pertaining to transportation. Moving it mechanically is better, cheaper and faster than moving it humanly.

Individual Conditions Govern Types.

The success of any industrial transportation system very largely depends upon the foresight exercised in the type employed, the layout, method of installation and location. Foresight, in the matter of industrial, or interplant transportation, is but another name for knowledge of conditions. And complete and thorough knowledge of all conditions is necessary to assure the success and economy of the system employed.

Not long ago one of the railroads leading into a southern metropolis designed and erected an enormous freight terminal. It was to be the last word in efficiency in material handling. The freight terminal was multi-story and hoist and conveying equipment was designed to carry and distribute the freight. And although the project seemed flawless and highly efficient on paper, the actual operation of the terminal proved it a colossal failure. Last reports have it that freight is here moved only at a cost of about 75 cents a ton and that engineers visit the place to gain a good idea of how not to erect a freight terminal. It stands a monument to lack of foresight, a dirth of knowledge of conditions.

There are places, such as in quarries or mines where the industrial or plant transportation systems are complete units in themselves—the system linking together all parts or department of the entire plant. In steel plants or foundries, however, transportation systems frequently serve only individual departments and have no connection with other departments. As an instance, we find industrial cars carrying raw material to the cupolas but these cars do not work in conjunction with that part of the plant transportation system which carries the molten metals from the cupolas to the pouring floors. In fact, the transportation systems employed throughout the steel industry are characterized by short, unconnected units.

Industrial railways form the major portion of the transportation systems in steel plants. Their employ-

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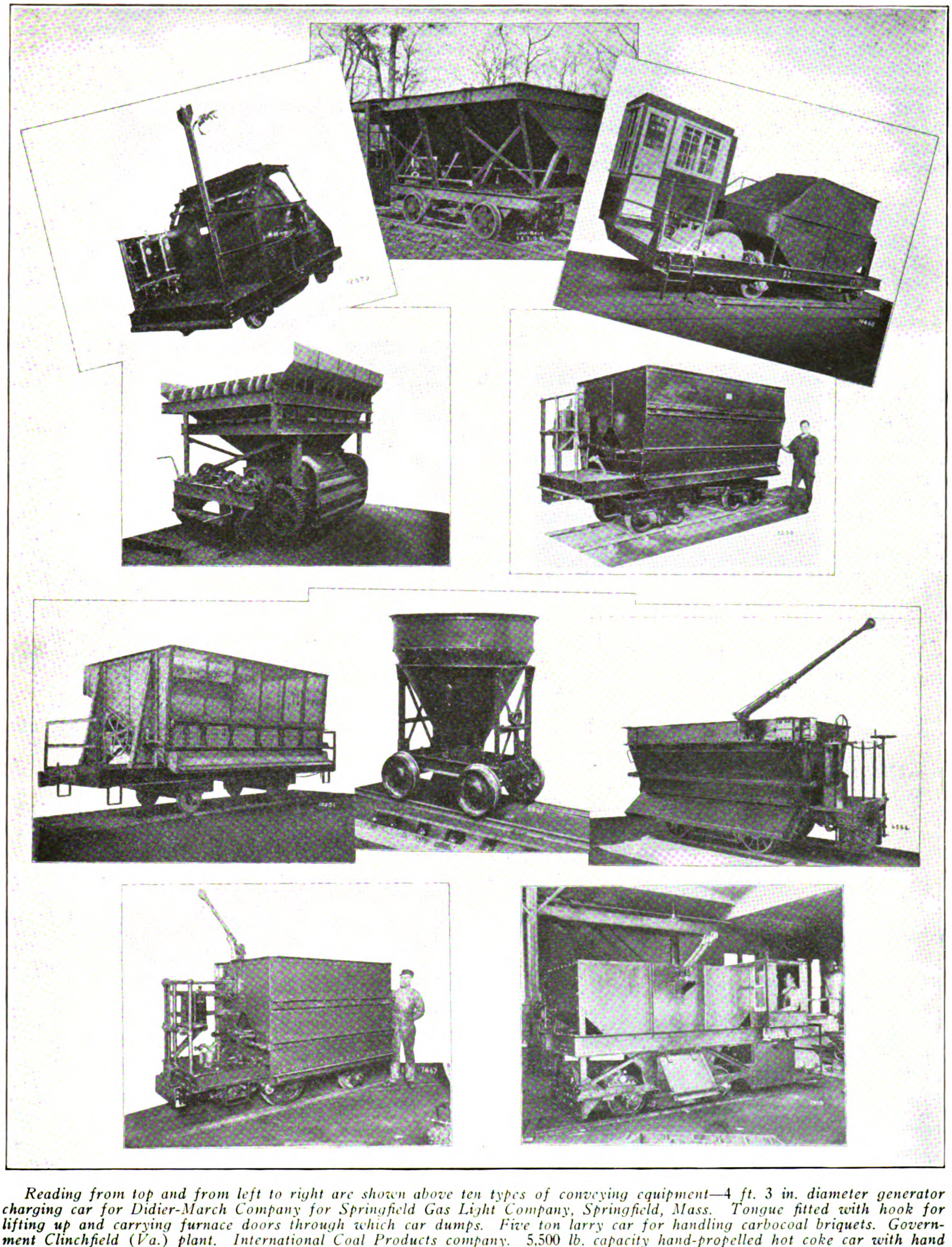
*Chicago, Ill.



*Reading from top and from left to right are shown above ten types of conveying equipment—4 ft. 3 in. diameter generator **charging car for Didier-March Company for Springfield Gas Light Company, Springfield, Mass. Tongue fitted with hook for lifting up and carrying furnace doors through which car dumps. Five ton larry car for handling carbocoal briquets. Government Clinchfield (Va.) plant. International Coal Products company. 5,500 lb. capacity hand-propelled hot coke car with hand operated rotary feeder for emergency use. Hartford City Gas Light Company, Hartford, Conn. Electrically propelled car for handling slacked lime, Philadelphia. Quench car for handling briquets of carbocoal—Interntaional Coal Products Corporation, Clinchfield, Va. 70 cu. ft. gable-bottom side-dump electrically operated car built for Virginia-Carolina Chemical Company, Lynchburg, Va. 24 in. track gauge, 3 ft. 9½ in. wheel base, 24 in. driving wheel, 10 hp. "G. E." motor. Speed 6 miles an hour —with 3600 lb. of acid phosphate on ½ of 1 per cent adverse grade. Self-propelling electric two-way side dump car. Capacity of tons. Capable of pulling also a 7-ton trailer car on 2 per cent grade. 160 cu. ft. electrically operated bottom discharge coke car, Illinois Glass Company, Atlon, Ill. Coal received from overhead bins and discharged to bins below. Discharged gate mechanically operated by man in the cab.***

ment has become so universal as to be a standard practice. Because of this universality, industrial railway transportation in steel plants is a subject for discussion in itself. We therefore pass over railway transportation with the mere presentation of a few pictures showing the various types of powered and unpowered industrial cars—as an illustration of the high degree of efficiency to which rail transportation has been developed.

Eliminating Men Through Electric Hoists.

The electric hoist is a vehicle of transportation not so widley used in steel plants and in manufacturies of products fabricated from steel, as they might be. Just why electric hoists remain more or less unrecognized as a means for transportation is a matter of conjecture. Perhaps it is a reflection on the name of the mechanism, for a great many electric hoists are now employed to lift or lower material. As a medium for transportation, however, they have not enjoyed universal application.

And this is working to the detriment of the industry for in a number of cases hoists are proving a most economical means of transportation. At the plant of John Maneely Company, Philadelphia, for instance, a 2½ ton hoist has been in successful operation for upwards of eight years. This hoist is mounted on a single girder bridge crane with a span of 42 feet and with a lift of 14 feet. The travel of the overhead crane is the length of the pipe shop which is approximately 200 feet.

The pipe shop is located midway between the fabricating shop and the ware house, and the material is brought in through doors running the entire length of both sides. The overhead crane picks up the bundles of pipe brought to the doors and carries them to either the machines or to storage. All this transportation work is accomplished by the crane operated by one man. The lengths of pipe bundles range from 18 to 22 feet and vary in weight ranging from a few hundred pounds to several tons.

In speaking of the performance of this crane, Mr. Dodds, superintnedent, said: "As an example of the efficiency with which this hoist operates, we can say that a large order for sprinkler pipes can now be filled in one-half day by one man, whereas, formerly, such an order would require the services of eight men, fully two days. The average saving throughout the year amounts to at least 2½ men a day, which, in terms of labor costs, totals over $3,000.

"The crane has a further advantage of permitting of higher piling of pipe. This enables us to keep larger stocks on hand, which saves the time of workmen on the drilling, cutting and threading machines. The floor space saved through the higher piling amounts to about 2,000 square feet which is an appreciated factor. As for the cost of operation; the depreciation on a 20-year basis, interest on the investment, maintenance and repairs, power requirements, etc., total a yearly charge of less than $500.00. We feel safe in saying that our hoist is effecting an annual saving of something over $5,000."

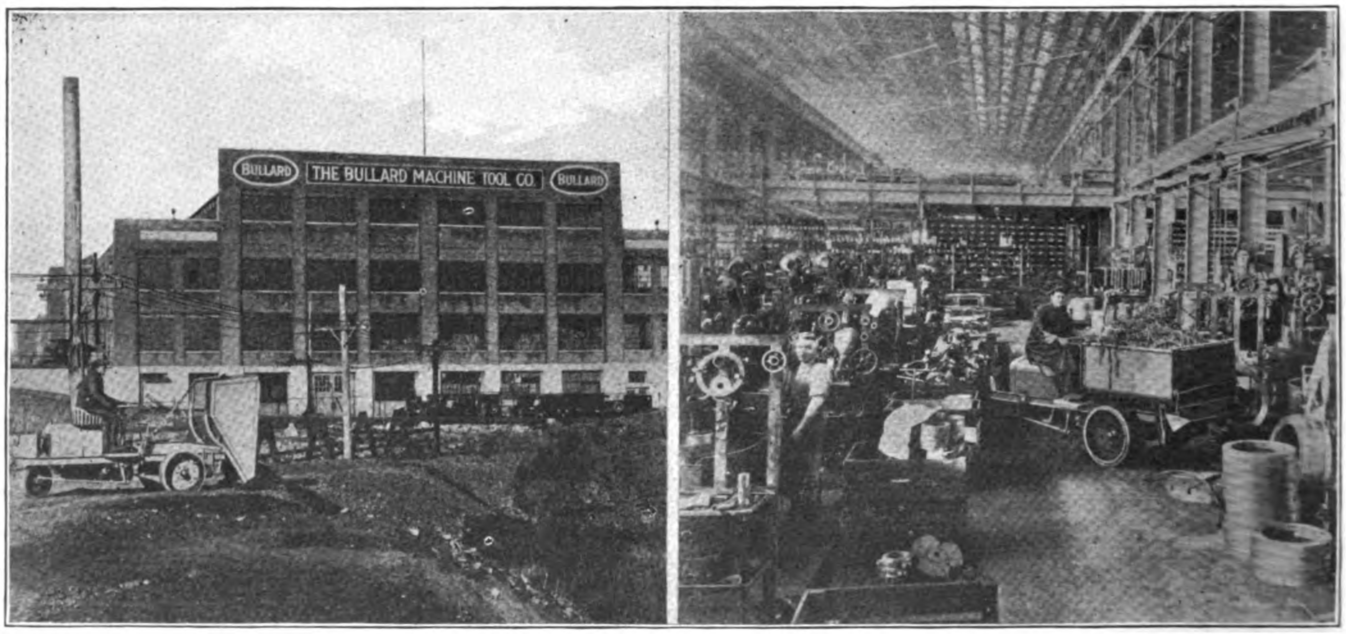
Self Powered Trucks Most Economical.

More easily applied than electric hoists, by reason of their ability to travel without a definite track, is the gasoline or electric truck, put into more or less universal use within the past 10 years.

A most interesting application of truck tractors was made recently at the Bullard Machine Tool Company, Bridgeport, Connecticut. Mr. Bullard, vice-president of this organization has made some study of this type of transportation and the statement he makes regarding their performance is not only interesting but highly enlightening. We quote:

"We employ two truck tractors in our plant, one of which has been in service for over four years, the other having been purchased about one year ago. The old machine is used in the machine shop and assembling department for handling chips and refuse, and for hauling all of the foundry refuse to the refuse storage and cares for the ashes from the boiler plant.

Machine No. 1 goes right into the machine shop or assembly department and collects the chips and refuse at the machines or containers. It hauls this material



Truck tractors performing a variety of functions in famous machinery building plant.

from the shop to the chip pile where it is dumped. This work is handled by one tractor operator and two helpers.

All of the sand used in the foundry is conveyed by tractors. This includes both new, and used sand, as well as refuse. Formerly we required the services of five men wth barrows, to care for the chips and refuse from the machine shop and assembling department. We also had to use one man a half-day for cleaning and general work; four men a half-day for handling the foundry sand and two men a part of the time on other work now performed by the tractors. The elimination of all of this labor through the employment of two truck tractors, two operators and two helpers, has resulted in a handsome saving in labor costs. We figure that the older tractor is earning an investment return of approximately 300 per cent.

Of interest to those who wish to calculate the savings effected by labor saving or labor aiding machinery is Mr. Bullard's mathematical calculations. This table can be used as a model by which savings effected by almost any machine can be calculated.

OPERATING COST OF TRUCK TRACTOR

Depreciation—$1,625.00 ÷ 5 years life	$ 325.00
*Average interest at 6 per cent— $\frac{6}{5} \times \frac{\$1,625 \times .06}{2}$	58.50
Maintenance and repairs	125.00
Total annual fixed cost	$ 508.50
Fixed cost per working day—$508.50 ÷ 280	$ 1.82
Gasoline cost per day	.42
Oil cost, per day	.15
Total machine cost per day	$ 2.39
Driver—9 hours × .55	4.95
Labor — 2 men × .50 × 9 hours	9.00
Total daily operation cost	$ 16.34

SAVINGS EFFECTED BY No. 1 TRACTOR—
IN MACHINE SHOP

Previous daily cost of handling chips and refuse (5 men × .50 × 8 hours)	$ 20.00
Previous daily cost of yard cleaning (1 man × .50 × 5 hours)	2.50
Transporting foundry sand (4 men × 4 hrs. × .50)	8.00
Other work done with tractor 2 men × 3 hrs × .50)	3.00
Total cost of previous method, per day	$ 33.50
Daily cost of operating tractor	16.34
Saving, per day, in labor costs	$ 17.16
Saving, per pear—$17.16 × 280	$4,804.80

SAVING EFFECTED BY No. 2 TRACTOR—
FOUNDRY REFUSE

Daily cost of tractor and driver, previous method	$ 15.00
Labor (4 men × 10 hrs. × .50)	20.00
Total daily cost of handling sand, previous method	$ 35.00
Cost of hauling ashes (2 men × 2 hrs. × .50)	2.00
Total cost of hauling, previous method	$ 37.00
Cost of doing same work with tractor	16.34
Daily saving in labor costs	$ 20.66
Annual saving	$5,784.80

No. 1 added to No. 2 equals:

$ 4,804.80
5,784.80

$10,589.60—annual saving effected through use of two tractors.

Combining Tractors With Lift Trucks.

An interesting example of how pneumatic lift trucks can be combined with truck tractors was found recently at a large Chicago manufacturer. At this plant six electric tractors are employed with over 200 lift trucks. The tractors are driven through the various departments of the plant at regular schedules, they conforming to those established schedules as rigidly as any railroad train. Finished parts ready for assembling, refuse to be taken to the car loading hoppers, finished products to be stored or transported to the shipping department are placed in boxes mounted on skid legs. These are hauled by lift trucks to established stations and allowed to remain until the next train comes along. Here the "train" or tractor operator will "hook on", hauling his train to its destination. As many as 15 lift trucks can be used as "cars" or trailers, the usual length of a "train" being seven or eight trailers. It is estimated by the production manager of this concern that through the employment of electric tractors and lift trucks fully 50 men a day are eliminated.

As remarked in the beginning, "The ability to move objects, people or thought, from one place to another, has, in a large measure, determined the progress of all peoples." Certain it is, the ability to move material is a determining factor in the progress of industrial concerns. To those who move their materials most rapidly, cheaply and efficiently is accorded the largest measure of success.

Coal and Coke in Low-Pressure Steam Plants

Accurate data on the effectiveness of combustion of bituminous coal and coke for generating steam under hand-fired low-pressure cast-iron boilers of a type actually used in heating large buildings have been obtained as the results of a study conducted by Interior Department engineers at the Pittsburgh station of the Bureau of Mines. The experimental work has been under way since early in 1922. The effectiveness of different methods of firing the different coals tested was determined, as well as the relative value of the different fuels used. The results showed that the bituminous coals from the Pittsburgh and Lower Kittaning beds, Pennsylvania, and the coke were of about equal steaming value at the lower pressures but at medium and higher pressures permissible with this equipment, the coke had about 90 per cent of the steaming value of the bituminous coal.

The new bridge across the harbor at Sydney, New South Wales, Australia, is estimated will need 50,000 tons of steel. A contract for this work was recently let to a British firm for £4,217,000 ($18,133,000 at current rate of exchange). A well known Pittsburgh firm (McClintic-Marshall) was one of the tenderers. The bridge is to be of the arch type, quite similar to the Hellgate bridge of the Pennsylvania Railroad in New York. About half of the steel plate will be rolled in Oustralia by the Broken Hill Proprietary at its Newcastle works, the balance coming from Dorman, Long & Company in England. The Newcastle plant, largely constructed by American engineering firms, including a number at Pittsburgh, now has three 500-ton blast furnaces, open hearth furnaces, and mills for rolling all sizes and shapes. By-product coke-ovens are also in use. The Broken Hill Proprietary originally operated one of the largest lead-silver-zinc mines at Broken Hill, and did have the largest smelter in the world at Port Pirie, South Australia, but started in the iron and steel business until now it has the large plant mentioned.

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*Allowing for interest earned by depreciation reserve.

THE SAFETY CRUSADE

Are Your Bulletins Obsolete?

Observers Quickly Lose Interest in Neglected Bulletin Boards

Take a look at the bulletin board in your shop, factory or office.

Read the announcement about Easter services in the churches and the other one about Miss Bresnahan getting married.

A bulletin board in many places is the mausoleum for dead facts, the place where events become mildewed.

If the Easter announcement was for Easter this year and not last year, then your bulletin board is kept up to date better than most bulletin boards. Probably Miss Bresnahan, now Mrs. Dillon, has already brought the new baby in to show to her old friends at the office.

The scarcity of real bulletin boards, carrying bulletins of current interest, became evident to the Policyholders' Service Bureau of the Metropolitan Life Insurance Company. The men of this bureau visit hundreds of business houses and factories every year. A study of bulletin board methods was made and a monograph has been issued on the subject.

Here are some of the high spots of this monograph:

"Care of the bulletin board should be the definite duty of some one person.

"As soon as its object is attained, a posting should be removed. Out-of-date notices hurt the value of the bulletin board.

"It is not necessary to post a new notice immediately to replace one taken down. An interval of blank space emphasizes the next bulletin.

"To impel frequent inspection a bulletin board must carry news.

"Whenever possible first intimation of any change in conditions or routine affecting the employes should appear on the bulletin board.

"Such notices together with announcements of policy will give the board news value.

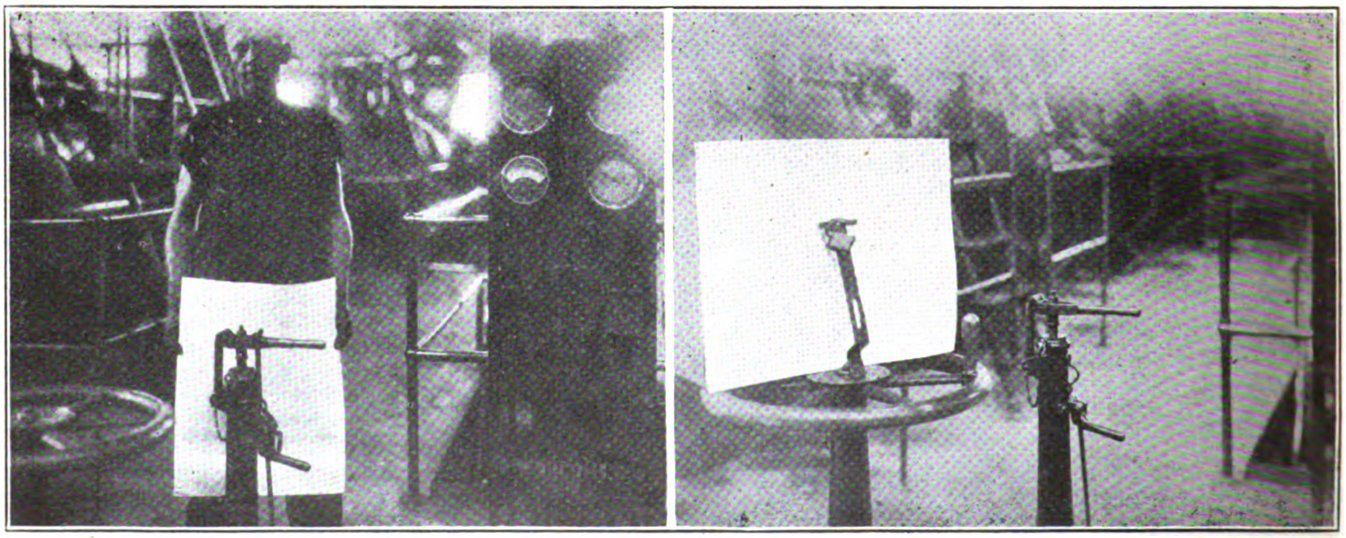
"News value can be enhanced by posting employes' lost and found ads, notices concerning employes' functions, etc."

The monograph contains also full instructions about selecting a good location for a board and the best method of construction.

Thirteenth Annual Safety Congress

What happened in safety during the past year will be the keynote of the Thirteenth Annual Safety Congress of the National Safety Council, which meets in Louisville, September 29 to October 3.

The story of progress will be related by speakers of national and international prominence, will be shown vividly by exhibits, motion picture films and lantern slides and will be demonstrated in the daily sectional sessions and general sessions of the greatest Safety Congress in history. More than 4,000 industrial plants and Community Safety Councils in 60 American cities, members of the National Safety Council, will be represented at the Congress. Indicative of increased safety activities and safety interest by industries is the increase in the membership of the National Safety Council. The membership is now the largest since the council was founded 12 years ago.



Alex. Barrowman (standing behind his invention), gas engineer at Joliet Plant, designs safety locking device for gas engine starting valves, at Illinois Steel Company.

It is planned to have Secretary of Commerce Herbert Hoover and Secretary of Labor James J. Davis speak at the Congress. The list of 275 speakers includes Richard F. Grant, president, Chamber of Commerce of the United States, Washington, D. C.; Dr. Arnold J. Jacoby, director, psychiatric clinic, Detroit; C. F. Kettering, vice president and chief engineer, General Motors Research Corporation, Dayton; James Herron, nationally known student of human problems in industry, Chicago; Ernest N. Smith, general manager, American Automoible Association, Washington, D. C.; Judge Shepard Bryan, Atlanta, Ga.; Mrs. Frank B. Gilbreth, Mount Claire, N. J.; Dr. Augustus Dyer, Vanderbilt University, Nashville, Tenn.; Dr. F. L. Hoffman, Babson Institute, Wellesly Hills, Mass.; Dr. A. H. Ryan, professor of physiology, Tufts College; Cyrus Ching, United States Rubber Company, New York City; Mrs. John Sherman, president, General Federation of Women's Clubs, Estes Park, Colo.; Bishop Woodcock, Episcopal Diocese of Kentucky, Louisville; W. W. Freeman, president, Union Gas & Electric Company, Cincinnati; D. F. Afflack, Universal Portland Cement Company, Chicago; Dr. C. E. A. Winslow, Yale University, and Dr. A. J. Pacini, Chicago.

Some industrial features of the Congress will be an extensive report of a study made by nationally known experts on the causes of benzol poisoning; a thorough report of research work into corrosion and its relations to safety in chemical plants; prevention of lead poisoning and health education of our foreign families. Industries are coming more and more to realize that the majority of accidents are due primarily to mental conditions of the individual and this attitude is reflected in the devotion of much time by the various sections of the Council to the fascinating study of the mental causes of accidents. Psychiatrists, psychologists, physicians and surgeons and laymen noted for extensive research into this phase of safety work are included on the Congress program.

The council will exhibit its new industrial safety film which is being produced at a cost of $10,000 and from six to ten other films dealing with safety in industry. One hundred new and unique types of safeguards which have been developed during the past year will be shown by lantern slides. Many of the industrial sections will have exhibits in connection with their sessions. These exhibits will consist of the mechanics of accident prevention.

Representatives of the American Automobile Association, the National Automobile Chamber of Commerce and the International Chiefs of Police Association will be brought together in the public safety program of the Congress. There will be a special street and highway exhibit consisting of records and charts, signs and signals, etc., used in street traffic control and regulation and public safety work.

A Punch Pressing Engagement

By J. F. Irby*

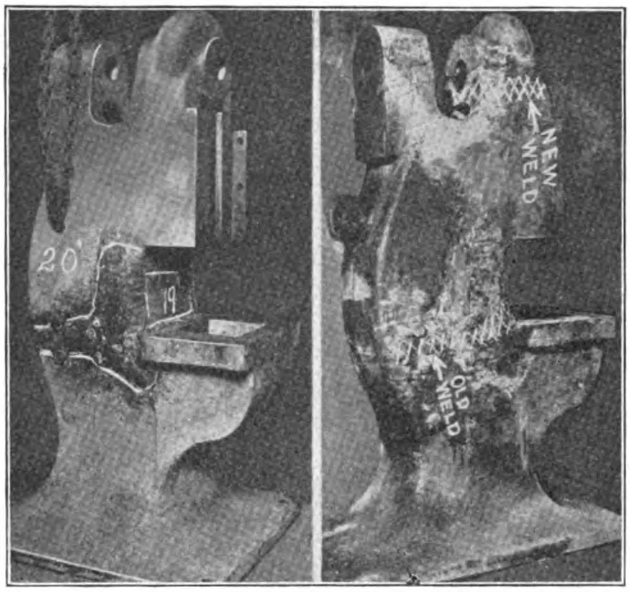
Every shop in the country working with metals may not have among its equipment a punch press of such dimensions as the one illustrated here. Still there are few shop owners that are not faced, at one time or another, with the spectre of a shut-down because of damaged machinery. Thus the main point in the following incident should be interesting as typical of the wide variety of repair and reclamation work done by welding.

We may start with the statement that when broken equipment is carefully repaired with a reinforced oxy-acetylene weld it is stronger at the repaired section than it was originally. Some skeptics might say, "Yes, probably," or "Undoubtedly, in a laboratory test, but does the same hold good in practice?"

It does! But to answer it most satisfactorily is to prove it.

Fig. 1 shows a punch press frame, a gray iron casting weighing approximately two tons. A piece of metal too thick or tough broke the casting square off at the level of the table. The frame was cracked through a hollow rectangular section 19 in. wide by 20 in. deep, 6 in. thick at front, 1½ in. at the back and 2 in. thick at sides.

After the edges were carefully veed and the frame accurately aligned, it was preheated by gas burners and a good welding job done by competent oxy-acetylene operators. The casting was carefully covered to protect it from any draughts during welding, and this covering was left in place until the casting had cooled.



Compound fractures.

After this proper annealing the punch press frame was put back in service and stood up under the work for a year. Then someone again fed it too big a bite and the frame broke. Of course, the frame was sent to same shop which had welded it after the first accident. It wes repaired and is shown in the second illustration ready for another term of service.

The point in the story is not that one good job deserves another, nor that the competent welder is an ever ready help in time of trouble, but that the second break did not run through the old weld. This was left unharmed. Nor was the new break within the region preheated for the old weld. It was in the crank bearing 4 ft. away. This then demonstrates the original proposition, that a second break in a properly made weld need never be feared.

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*Allmetals Welding & Mfg. Company, Baltimore, Md.

Engineers' Society of Western Pennsylvania Moves Into Larger Quarters

Transformed Hawaiian Room Meets Expanded Needs of the Organization

PITTSBURGH has one of the oldest and largest local engineering societies in the country, the Engineers' Society of Western Pennsylvania, organized and chartered under the laws of Pennsylvania in March, 1880. Starting wit ha membership of 110 it has kept pace with the growth of the city until it now has 1,500 members.

The first quarters occupied by the society were at 410 Penn Avenue. The first meeting was held on March 20, 1880. Many scientific men of national and international reputation have served as officers and assisted in placing the organization in the important position it holds today. Among those who served as president in the early years are William Metcalf, Dr. John A. Brashear, Thos. H. Johnson, Thos. P. Roberts, George S. Davison and E. B. Taylor. Several changes in quarters have been made in keeping with the growth of the organization and in November, 1921, they moved into the William Penn Hotel. Their location has proved so popular that they have been obliged to increase their space by securing the Hawaiian Room, giving them a large attractive club room and an administration office.

Service to the community, industry, and the engineering profession is the object of the organization. Thirty technical meetings a year are held for the purpose of keeping the members in touch with the latest developments in engineering and to give them an opportunity to exchange experiences and ideas. Papers and discussions presented are published in the monthly proceedings, forming valuable reference books. These proceedings have a circulation of about 2,000 and are to be found in libraries all over the country. Other activities include periodic inspection trips to plants in

An intimate picture of commodious club facilities now extended to engineers of Western Pennsylvania.

and about Pittsburgh, social events, including an annual banquet for which speakers of international reputation are secured. Over 1,000 engineers and executives attended last year's dinner. Special tables are reserved in the cafeteria of the William Penn Hotel forming a noonday meeting place for a large number of the downtown members. The total attendance at all functions of the society last year was 4236.

The present officers are Frederic Crabtree, president; Walter B. Spellmire and William E. Fohl, vice presidents; A. Stucki, treasurer, and K. F. Treschow, secretary.

Butesin Picrate—A New Treatment for Burns

By Floyd K. Thayer*

In spite of the very extensive research done in the last 50 years, on both, naturally occurring and synthetic medicinals, it is a rare matter to find antiseptic and anesthetic action combined in the same compound. Where both actions are found, one or the other is quite certain to be only incidental to the main physiologic function of the compound; for example: The mild analgesic action of phenol compared to its germicidal power, or the very slight antiseptic action of anesthetics of the anesthesin and orthoform type.

To increase the dosage to a point where both functions would be definitely apparent, is likely to bring about undesirable and perhaps toxic reactions. The advantages of a compound possessing both, anesthetic and antiseptic action in a marked degree, are quite obvious. While new uses for such a chemical might occur to the ingenious practitioner, yet there can hardly be a more important objective than its application to the treatment of burns.

Picric acid has long been known to possess antiseptic properties. Its phenol coefficient, as given by various authors, varies from 4 to 7. Recent literature points out the value of picric acid as an antiseptic, especially in the treatment of burns.

Knowing the property of picric acid to form salts with many basic compounds, it occurred to us that it would be desirable to combine it chemically with an anesthetic. The anesthetic chosen was Butesin, which is of the water-insoluble type and two to four times as strong as Anesthesin. Chemically, Butesin is the n-butyl ester of para-aminobenzoic acid.

Butesin Picrate is formed by reacting aqueous solutions of picric acid and butesin hydrochloride. The product separates as a yellow solid having a melting point of 109 deg. to 110 deg. C. It is odorless, but has a slightly bitter taste. Its solution does not stain to anywhere near the same degree that a picric acid solution does. The new compound contains, 71.6 per cent butesin and 28.4 per cent picric acid.

Butesin Picrate is soluble in water, 1 part in 2000; in cottonseed oil, 1 part in 100. In alcohol, ether and benzene it is readily soluble.

Butesin Picrate, synthesized with the double purpose in view, of obtaining anesthetic and antiseptic action in the same chemical compound, was submitted to not only pharmacological tests, but to bacteriological as well.

As a means of ascertaining its anesthetic efficiency, and at the same time testing for possible irritation, the eye of a rabbit was flooded with a 1:2000 aqueous solution of Butesin Picrate for one minute. Immediately thereupon, the point of a pencil was drawn across the cornea of the eye without the rabbit showing the slightest sign of winking. This is classed as immediate anesthesia. The duration was from 15 to 20 minutes. At no time was any irritation noticeable.

Bacteriological tests were made by dissolving Butesin Picrate in sterile distilled water—1 part to 2000. A culture of bacteria isolated from a burn and containing streptococci and staphylococci was placed in contact with this aqueous solution. Subcultures, taken after intervals of 1, 2, 3, 4, 5 and 6 hours, failed to show any growth whereas an immediate subculture displayed a heavy growth.

For clinical purposes Butesin Picrate is marketed in two preparations. It is incorporated in a base composed of white wax, paraffin, mineral oil, borax and water. A cottonseed oil solution is likewise used. Both of these preparations contain 1 per cent of Butesin Picrate.

In a large steel plant, near Chicago, hundreds of burn cases, ranging from first to third degree burns, have been treated with Butesin Picrate preparations, with results which the surgeon in charge characterized as "very wonderful."

This new treatment has been found efficacious on electric burns as on steam and hot metal burns. One doctor writes that burns heal in about one half the usual time under Butesin Picrate.

So strongly analgesic is the action of this anesthetic-antiseptic that all burning sensation disappears within 15 to 30 minutes. The ointment anesthetizes the cornea as readily as the aqueous solution.

After using the Butesin Picrate treatment in a large number of burn cases, one doctor reported how pleased he was to find an almost entire absence of that offensive odor so often encountered when the first dressing is removed. This was just another way of saying that there was freedom from saprophytic action.

Success of this new remedy has not been confined alone to burns. Ulcers, lesions, and other painful, denuded skin areas respond in a most gratifying manner to treatment with Butesin Picrate Ointment. Here again, as in the case of burns, prompt relief from pain is afforded and, at the same time, under strictly aseptic conditions.

In order to discover if any toxic symptoms might result, should absorption take place after application of the ointment to large areas of denuded skin, over four and one half cubic centimeters (4½ Cc.) of saturated aqueous solution of Butesin Picrate, per kilogram bodyweight, was injected directly into the circulation of a rabbit and without the slightest untoward effect.—The American Journal of Clinical Medicine, March, 1924.

Tar Yield of Western Lignites

A large number of assay retort tests of samples of lignite taken from public lands in the western states have recently been made by the Interior Department at the oil-shale laboratory of the Bureau of Mines, Boulder, Colorado. The Colorado lignites so far tested yielded from 8 to 10 gallons of tar to the ton. Samples of Wyoming lignite yielded as high as 20 gallons to the ton.

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*Research Chemist, The Abbott Laboratories, Chicago, Ill.

CURRENT REVIEW

Iron Trade Review

August 28.

Steel output is gradually rising, production again being about 50 per cent for the first time since June. Railroads are coming into the market for 250,000 tons of rails and are negotiating for 12,000 cars. The pig iron market continues to gain strength, with an increase in the melt. More users are closing for their fourth quarter requirements.

Iron Trade Review's composite of 14 leading iron and steel products this week is $39.35 against $39.37 in the preceding week, $41.14 three months ago and $44.84 a year ago.

In the foreign markets the feature this week is the anxiety expressed in Great Britain and France respecting a possibility of increasing competition from the German source as negotiations over the Dawes plan reach consolation. Sales are being made by the German manufacturers in Birmingham, England under the British market price. A report from Brussels states that 30,000 Belgian miners have gone on strike for higher wages.

An article in this issue by Joseph Horton, British correspondent of Iron Trade Review outlines the plan in use in Great Britain for exporting tin plate. The British manufacturers are shipping abroad annually nearly five times the tonnage sold abroad by Americans, their cargoes going regularly to 16 countries.

J. W. Bolton contributes an article to this issue giving the results of studies of the structure of gray iron. He describes macroscopic and low power magnification methods which reveal the general structure of gray iron and semisteel. This article is accompanied by many photographic specimens.

September 4.

Pig iron shipments continue to increase in volume and the undertone of the market is strong, the higher levels recently adopted appearing more firmly established. The four months' decline in pig iron production was checked in August which is the first month to show increase since March. The total production in August was 1,874,920 tons against 1,783,457 tons in July. The August rate represents 54 per cent of that in March. Railroads are putting out more inquiries for equipment and 17,000 cars now are pending.

Iron Trade Review's weekly composite is $39.23, the lowest since August, 1922, and compares with $39.35 in the previous week and $44.68 one year ago. The cessation of the British structural strike is creating a renewed demand for material in that country. The strike checked business in that country for more than seven weeks.

Vincent Delport, French correspondent of Iron Trade Review contributed to this issue an article describing the business and technical features in the building of locomotives in France.

September 11.

Evidence of a revival in the steel market is more general. Railroads have placed 12,000 cars in the week and opened new negotiations.

August gain in steel ingot production after three months of decline proves to have been greater than was previously indicated and represents a gain of 36 per cent over July, the production in August going up to an annual rate of 30,400 tons compared with 22,360 tons in July, this is on the basis of 60.5 per cent of the rate of ingot production in March which was the highest in history. Despite the upward trend in prices of pig iron and scrap, a slight dropping tendency in the general market is registered, but Iron Trade Review's composite fo 14 leading iron and steel products is $39.15 against $39.33 the previous week and an average of $39.33 for August.

This issue is devoted largely to material of special interest to those concerned with the testing of material. An article deals with the field of magnetic testing and describes recent progress. Another outlines methods for inspection of stock by the Brinell test. The technic of X-ray testing is improving, as outlined in an article detailing the experience at the Watertown Arsenal in the application of X-ray process to steel castings. Numerous illustrations are given with these articles.

Complete details are given pertaining to the sixth annual convention of the American Society for Steel Treating in Boston, September 2.

September 18.

A slightly easier tendency is noted in some districts with respect to pig iron prices, as the majority of melters have closed for their fourth quarter needs and furnaces decline to quote for the first quarter of 1925. On a 4,000 ton inquiry for foundry iron for the first half of 1925, $19, lake furnace and $19.50 valley, were named. .

Iron Trade Review's composite this week shows another decline to $38.95 against $39.15 in the preceding week shows another decline to $38.95 against $39.15 in the preceding week, weakness in steel prices being the principal cause. Eastern plates are offered at 1.60c to 1.70c per pound. Some of the Valley producers of sheets, bars, billets and slabs have abolished the basing point differential as between Valley and Pittsburgh. The railroads are the heaviest buyers in the steel markets at present.

Some hesitancy is expressed in the Western markets as the time is near for the effect of the Federal Trade Commission's cease and desist order, with respect to Pittsburgh basing point controversy. The Steel Corporation has not announced its future course and has not availed itself of the opportunity to appeal, at this date.

More blast furnaces are going into operation, but the recovery in this department and in steel making is moderate.

The forecasting of machine tool building and equipment demand, by means of charts and reference to business cycles is outlined in this issue by Ernest F. Du Brul.

A complete report is given of the autumn meeting of the Iron and Steel Institute, Great Britain, in London, September 4. The feature in the meeting was the address by the president urging British manufacturers to adopt more intensive methods of labor and fuel saving.

Friends of James A. Campbell, president of Youngstown Sheet & Tube Company attended a dinner in Cleveland September 11 on the occasion of his 70th birthday. The dinner was attended by Charles M. Schwab, E. G. Grace and other prominent steel men from other cities.

Recent Patents, U. S. and Foreign

Producing ferrochrome and other ferrous alloys. D. W. Berlin. E. P. 201,520, 19.2.23. Conv., 26.7.22.

Electrodes formed from a mixture of chrome or other ore, an exothermic reducing agent, e.g., silicon or silicon-aluminium, and a binding agent, are coupled in an electric furnace in contact with molten slag or metal. The ore is reduced and gradually melted into the bath. The electrodes may be made of higher conductivity by embedding iron or an alloy of iron in the mass.—C. A. K.

Producing rustless iron and steel. D. W. Berlin. E. P. 202,952, 27.2.23. Conv., 28.8.22.

Chromium or an alloy of chromium is formed into electrodes and caused to melt into a bath of iron by means of a suitable electric current. The operation may be effected in an ordinary Martin furnace. (Cf. preceding abstract.)—C. A. K.

Process of coating metals (e.g., iron with chromium). H. C. P. Weber. U. S. P. 1,497,417, 10.6.24. Appl., 31.3.20.

An article of iron or an iron alloy is cleaned, dried, covered with a layer of chromium chloride, and placed in an evacuated space. On heating ferric chloride is formed and volatilizes, while a coating of chromium is obtained on the article. The depth of the coating is controlled by the temperature and time of treatment, a layer 0.2 mm. thick being obtained in 4 hrs. at 1000 deg. Coatings of tungsten, molybdenum, uranium, zirconium, and other difficulty reducible metals on iron or other metal or matelloid may be obtained in this way. In place of the chloride, other volatile compounds of the metals to be applied, such as the cyanides or carbonyls, may be used. The coatings are very resistant to oxidation even at high temperatures.
—T. S. W.

Alloy steel. W. N. Bratton, Assr. to Climax Molybdenum Co. U. S. P. 1,498,071, 17.6.24. Appl., 5.-12.23.

A steel containing 1—2.5 per cent Mn. up to 1.25 per cent Mo, up to 1 per cent C, and up to 3.5 per cent Ni, together with other ingredients if desired, is very tough.—T. S. W.

Composition for hardening steel. W. C. Bassett. **U. S. P. 1,499,285, 24.6.24.** Appl., 18.11.22.

A case-hardening mixture contains over 50 per cent of sawdust; the remainder consists of charcoal together with a smaller amount of sodium carbonate and magnesium carbonate, the last two constituents together being somewhat over 5 per cent.—G. S. W.

Drawing, rolling, and wire-drawing metals. G. de Dudzeele. E. P. 210,719, 27.3.23. Conv., 5.2.23.

The surface of the metal to be treated is amalgamated by any known method, e.g., by dipping in a 10 per cent aqueous solution of mercuric chloride. The coefficient of friction of the surface is so reduced that several successive mechanical treatments may be effected without the necessity of cleaning or annealing after each operation.—C. A. K.

Production of aluminium and silicon and other elements from aluminiferous substances such as clay or bauxite. L. D. Hooper. E. P. 217,376, 14.4.23.

In the production of aluminium from aluminiferous material, such as clay or bauxite, iron and other metal oxides and silica present in the material are reduced to the elements by heating with sufficient aluminum to reduce all the oxides except the alumina, and alumina is separated from the product, and subsequently converted into aluminium by the usual process. Variations which may be made in the process according to the composition of the material, include the addition of silicon, ferro-silicon, iron, silicon carbide, or carbon, or mixtures of these, or of fluxes such as fluorspar and cryolite to the charge heating the mixture in vacuo or under any suitable pressure; and carrying out the process in the presence of air or other gases. When reduction is complete, alumina is separated from the other constituents of the mass, either by so adjusting the charge and the conditions that the reduction products and the alumina separate in two layers, or by producing a mixture which can be ground to a powder, and then separating iron and other reduction products by magnetic means. (Reference is directed, in pursuance of Sept. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E. P. 6132 of 1902 and 14,572 of 1900.)—L. A. C.

Wet magnetic separation of material by means of roller or cylinder separators. P. C. Rushen. From F. Krupp A.-G. Grusonwerke. E. P. 217,817, 9.10.23.

Liquid is sprayed onto the surface of the roller magnet, or stationary drum, above the level of the slime, so that a film of liquid is carried down on the surface of the roller into the slime. The magnetic material in the slime is drawn onto the face of the roller within this film and is removed by a jet or scraper. In the case of an inclined separating plant, the axes of the rollers are adjustable so that the film liquid meets the slime at any desired point. The process is applicable to magnetic rollers or to stationary drums with internal rotary magnets and external counter poles.—G. S. W.

Metallurgical (open-hearth) furnaces. F. H. Loftus. E. P. 217,943, 22.1.23.

The fuel gas from the regenerators of an open-hearth furnace is delivered, under pressure, through a nozzle into a mixing chamber, crossing the air uptake. A jet, supplied with preheated air from the regenerators by a "booster" fan, is situated at the back of the gooseneck opposite the nozzle in order to increase the velocity of the flame and to promote more perfect combustion. If combustion in the mixing chamber is too fierce, it may be damped by supplying waste gas to the "booster" jet in place of air. The gas nozzle and mixing chamber are designed so that a wide shallow flame is directed onto the hearth of the furnace and away from the walls and roof. A small air port is situated above the mixing chamber to provide a blanket of air around the roof and walls as a further protection from the flame. The gas nozzle is lined throughout with refractory material and may be water-cooled. With the exception of the "booster" jet controls, the design of the furnace does not involve the use of any additional valves besides the usual reversing valves.

—G. S. W.

Alloys. E. C. R. Marks. From Kemet Laboratories Co., Inc., E. P. 217,991, 26.3.23.

Binary alloys of iron and aluminum containing more than 9 per cent Al exhibit high electrical and heat resistance, but are brittle. The addition of manganese or chromium increases the ductility of the alloy and enables it to be worked. Alloys of suitable composition contain Al 10—16 per cent (12 per cent), Cr less than 20 per cent (19 per cent), C not more than 1 per cent—C. A. K.

Froth-flotation concentration of ores and the like. Minerals Separation, Ltd. From Minerals Separation North American Corp., Ltd. E. P. 218,012, 20.3.23.

Ore pulp is subjected to a froth-flotation separation using a frothing agent, such as xylene or solvent naphtha, containing a large proportion of aromatic hydrocarbons characterized by the presense of one or more methyl groups. Xylene alone can be used with advantage, particularly in separating galena from blende and pyrites. With toluene and to a greater extent with the higher members of the series, there is a tendency for blende to pass with the galena into the froth. The frothing re-agent may contain heavy aromatic coal tar derivatives (cresol, naphthalene, anthracene, etc.) or asphaltic material in solution. Such heavy hydrocarbons or the like stabilize the froth and increase its carrying capacity. These flotation agents may be used for concentrating a more valuable metal in the presence of iron, e.g., zinc or copper mineral from ores containing iron pyrites. The process may also be adjusted to obtain a series of concentrates of different metals from an ore as in the case of a lead-zinc-silver ore.—G. S. W.

Centrifugal separator (for recovering precious metals). E. I. and Le R. D. West, Assrs. to W. H. Raplee. U. S. P. 1,498,768, 24.6.24. Appl., 12.7.23.

The material is delivered from a feed hopper to a horizontal rotary barrel provided with annular ridges on its inner surface. The hopper communicates with a central bore in one end of the barrel. The other end of the barrel is closed by a hollow member provided with radial ports adjacent to the end of the barrel, and surrounded by a fixed casing into which the separated material is drawn by a pump.—H. H.

Boiler corrosion and treatment of boiler feed water. A. Winstanley. Water and Water Eng., 1924, 26, 65—69.

In a number of boiler installations in which pitting occurred the lime-soda method of feed water treatment was used and prevalence of sodium salts (particularly sodium sulphate) in the water was noted. Experiments were therefore made to determine the effect of concentrated solutions of these salts on boiler steel. Distinct pitting, visible to the naked eye, after 6 months, and pitting visible under a hand lens, after 9 months, occurred in bars of new boiler steel suspended in boilers the feed water of which contained 18.62 and 9.74 grains of sodium sulphate per gal, respectively, increasing to 1762.8 and 760.4 grains per gal. after the normal period of running. The quantity of salts in solution was considerably less after treatment with barium hydroxide than after the lime-soda treatment. The approximate weights of sodium sulphate and chloride required for saturation of water boiling under pressures up to 100 lb. were determined. For sodium sulphate the concentration varied from 26,465 grains per gal. at 10 lb. to 25,380 at 100 lb., and for sodium chloride from 28,000 at 10 lb. to 22,040 at 40 lb. The temperature of the water was in each case higher than that of the steam, a condition which not only leads to loss of heat but also produces foaming.—R. E. T.

Nickel Production in Canada

The revised statistics of nickel in Canada for the year 1923 show that there has been a marked revival in production. The output last year was 62,057,835 lb., contained in cupronickel matte, as compared with 17,355,056 in the previous year, whilst the nickel contents resulting from the treatment of silver-cobalt ores increased in 1923 to 396,007 lb. from 242,067 lb. in 1922. The total computed value of the nickel production was $18,332,077, based on a value of 29-35 cents a pound. The total amount of ore mined by the three companies, Mond, British America and International, was 1,187,355 tons. The output of nickel for the three months of this year shows an increase of 74 per cent, compared with the corresponding period of the past calendar year. The precious metals recovered during the first quarter of 1924, by the nickel refineries, were as follows: Gold $4,988, silver $10,266, platinum $50,901 (495 oz.), palladium $42,586 (638 oz.), rhodium $20,476 (276 oz.), ruthenium $12,820 (105 oz.).

BOOK REVIEW

By E. H. McCLELLAND*

Coal Carbonization, by Horace C. Porter. 442 pp. 1924. Cloth. $6. Chemical Catalog Company, Inc., 19 East 24th St., New York City. (American Chemical Society. Monograph Series.)

In these days of specialization it is increasingly difficult to keep pace with technical progress, and there is always a welcome for a new book which bears the stamp of authority and which affords an adequate survey of any important industry.

Not the least gratifying feature of a technical book is a preface in which the author directly and concisely tells the reader exactly what he intends to do. As an example of what a preface should be, there are few better instances than that in Dr. Porter's "Coal Carbonization," and the following review, which is primarily descriptive rather than critical, is based in part upon this preface and upon the Introduction by Professor S. W. Parr, who, like the author, is well known in the field of fuel technology.

Of the rather limited number of books on coke appearing during recent years, the greater number have been European, and most of those in the English language have been produced in England where many of the problems are essentially different from those in the United States. There is, therefore, ample justification for a book by an American writer, and the author—a chemical engineer, for many years engaged in fuel investigations with the United States Bureau of Mines, and for a time with the Koppers Company—brings to his task a rich fund of scientific training and technical experience.

For approximately 75 years, or until the end of the nineteenth century, the carbonization of coal was carried on in substantially the same way as at the outset, with but slight attention to modifications or improvements; but during recent years, many highly trained specialists have given their attention to unfolding the complexities of the subject, and great progress has been made. As a consequence, the subject of coal carbonization is now too extensive to be treated **exhaustively** in a single volume. The present work, however, is **comprehensive,** and is thorough to the extent of outlining the economic situation, incorporating the essential theory, describing the industrial equipment for coal carbonization and explaining its operation, and discussing the more important products. The book is provided with copious footnote references to original sources of information, and it is significant of the rapid recent development in this field that most of the references which the author finds it worth while to cite are to literature published within the last four or five years.

The book does not deal with historical development nor with present (and to a limited extent, future) conditions. The treatment is well balanced; the author sponsors no one system, but attempts to give a typical cross-section of the industry today. It is an unbiased treatise in which topics are treated in accordance with their relative importance as determined by the present status and trend of the industry.

Chief attention is given to coking and gas making at high temperatures. Today, on the basis of capital investment and value of products, by-product coking constitutes 75 per cent of the carbonization industry in America, and gives promise of retaining a relatively prominent position for some time to come, and we find that approximately half the book is devoted to the working of by-product coking plants, various types of by-product ovens, heating of the ovens, and recovery of by-products. The description of ovens is confined to types in use in the United States, and these are described in great detail with numerous illustrations and diagrams. A list of other types is given with citation of references to descriptive articles thereon, thus giving the book a reference value beyond the scope of its text. Low-temperature and miscellaneous processes are dealt with briefly, two chapters deal respectively with "The Gas Industry" and "The Processes of Gas Manufacture by Coal Carbonization," and the final chapter is concerned with "The Application of the Products of Coal Carbonization." An appendix contains a number of useful tables and charts on such subjects as composition of coals, yield of coke, data on oven charging, and plant lay-out. One of the most interesting is a chronological table of by-product coke plants in the United States. The fact that this table has been corrected up to March 1, 1924, is but one of the evidences throughout the book that the author has brought his work up to date.

The book is primarily "for the average technically trained man, chemist, business executive, or engineer, who requires a knowledge of the principles and an outline of the practice in coal carbonization." Though it does not go into great detail regarding the uses of coke, it will be of service in the steel industry as blast furnace gas is now an important item in coke manufacture, and more than three-fourths of the coke produced finds application as blast furnace fuel.

Dr. Porter's "Coal Carbonization" is easily one of the most directly useful of the "Monograph Series" being issued under the auspices of the American Chemical Society. Like many (but not all) of the other works in this series, it contains a table of contents which is more than a mere list of chapter headings. This detailed table of contents is a valuable feature which should be embodied in every technical book, as it is the only medium through which the reader is enabled to make a quick survey of the scope and arrangment of the work. Such a table of contents should not be expected to perform the functions of an index, but in the present work it may serve to supplement the "Index of Subjects" which is carelessly made and very inadequate. Judging by evidences of inconsistency with the orthography of the text, this "Index of Subjects" is not the work of the author. There is little attention to synonyms and cross-indexing and it fails to bring out satisfactorily the subject matter of the text. For example, there is only a single entry under "By-product," and only one each under "Cost" and "Costs."

The book is a creditable one. In the words of Professor Parr's Introduction, "The author is peculiarly well fitted by both training and experience for his task and as a result there has been brought together a fund of information not otherwise accessible in any compact and convenient form. His treatment of the entire field has been impartial, conservative, scientific, and both the author and the industry are to be congratulated on the result."

"Anhaltszahlen for den Energieverbrauch in Eisenhuettenwerken." (Datas on Energy Requirements in Iron and Steel Plants), by the Heat Economy Bureau of the German Iron and Steel Institute. 74 pages 7½x10¼. $1.75 at P. F. Hermann, Century Building, Pittsburgh, Pa.

The book is of utmost interest and gives all kinds of datas for energy use in coke ovens, blast furnaces, open hearth furnaces and converters, rolling mills, just as well as exact datas on energy with every power machine and other equipment used in iron and steel works. There are, for example, every type of steam turbines, gas engines; also losses in electrical transmission of energy are given. Especially the rolling mill datas are very complete and include not only roll train resistance of the different kinds of mills but also fuel consumption of soaking pits, heating and forging, annealing and enameling furnaces, etc. All in all, it is a big mass of information given in a very simple way. The only disadvantage is the German language, but, of course, there are many people around who understand this language so that this book should receive the big circulation that it deserves.

"Waermestrombilder (Sankey Diagramme) Aus Dem Eisenhuettenwesen" (Diagrams and Tables on Heat Circulation in Iron and Steel Works), by the

Heat Economy Bureau of the German Iron and Steel Institute. 20 pages 7½x10½. 70 cents. Paul F. Hermann, Century Building, Pittsburgh, Pa.

In quite a clear way and by tables which are only too good to be understood this very interesting booklet shows the use of heat in coke ovens, in blast furnaces, the losses of wind in cowpers, the gas distribution produced by the blast furnace as energy to the different equipment machines, etc. The heat circulation in converters and the heat economy of gas producers are shown. Very exact datas are given on open hearth furnaces, also on rolling and forging furnaces. There are still some other tables and at the end large tables which show the heat distribution in different big plants, divided by fresh heat and use of used heat. This is a very useful booklet for every plant engineer in iron and steel business.

The Science of Metals—Book Review

By Zay Jeffries and Roberts S. Archer

In the development of the vast complex of products and processes incident to our modern civilization, it is the rule that art precedes science. Man usually learns how before he learns why. The great variety of metal products now available, and their processes of manufacture, were developed largely by means of endless experiments without the help of general guiding principles. Metals and alloys which have been made and used for thousands of years have been subjected to scientific study for only about a half century. More and more attention has been devoted to the systematic investigation of the structure and properties of metals and alloys until, at the present time, the rate of accumulation of data is almost too rapid for digestion. We are in possession of a great store of facts, in whose assimilation the beginner may well become confused. The need is for a better classification and a more fundamental analysis of this knowledge.

"The Science of Metals" is a very definite attempt by Jeffries and Archer to present clearly and relatively the fundamental principles upon which the theories of metallic structures have been built. Throughout the 450 pages copious references are made to original investigators, and due credit is given to those whose labors have contributed to present accumulated knowledge.

Every chapter proceeds to its calculated conclusion clearly and concisely. Two chapters carry unusual clarity and interest, Chapter V, Grain Growth and Recrystallization, and Chapter IX, Constitution of Alloys.

Chapter V, Grain Growth and Recrystallization—Grain growth obviously results from tendency of matter to assume the form of greatest physical stability, which is the form of least energy. The crystallization of metals from the liquid state is always accompanied by an evolution of heat, representing the loss in kinetic energy of the atoms incident to their fixation in the rigid crystal lattice. The atoms at the surface of a liquid or solid body are less subject to the attraction of their neighbors than are the atoms in the interior. They are, therefore, more free to move and consequently possess more energy of motion. A "free" surface of any body is thus a locus of extra energy, known as "surface energy," or sometimes "surface tension." There is, therefore, a tendency for small particles, such as drops of a liquid or crystals of a solid, to unite to form larger particles, since in doing so they diminish their surface area and hence their total energy. It follows that the most stable form for any piece of metal would be a single crystalline grain.

To have the smallest possible surface area, this grain should be spherical in shape. This would not, however, necessarily give the minimum surface energy, because of the geometrical properties of the crystal. The most stable shape for a crystalline substance is often an idiomorphic form built up of the natural crystal faces. On the other hand, it is well known that small particles of certain crystalline constituents in a metallic aggregate tend on long heating to assume a spherical form. The most stable form of a metallic crystal is that of least surface energy, which will probably be either idiomorphic or spherical.

There has been considerable confusion in the literature on grain growth, arising from a lack of distinction between true or stable equilibrium and metastable equilibrium. Grain growth is a process involving inertia which must be overcome, just as the friction of the material composing a mountain must be overcome before the force of gravity can level it with the plain. Similarly, the fact that, even after prolonged annealing above the recrystallization temperature, grains may be found having jagged or irregular outlines does not in any way disprove that smooth outlines would represent a condition of greater thermodynamic stability. Obviously, any roughness on the surface of a crystal is a source of increased surface energy, and hence diminished stability.

Chapter IX, Constitution of Alloys—Most alloys are aggregates, in that they are made up structurally of two or more physically different constituents. The properties of an alloy, or aggregate, are determined by the quantities of the various constituents, their distribution, their specific properties and, to a smaller extent, by the surface forces between them. A rational understanding of the properties of alloys, therefore, requires a knowledge of alloy construction; that is, of what constituents are present under various circumstances, and in what proportions.

The problem of alloy constitution is complicated by the fact that under ordinary conditions alloys are often not in a state of physicochemical equilibrium. The internal changes which must take place to establish equilibrium proceed slowly because of the rigidity of the solid state, and at low temperatures may be entirely arrested, so that an unstable structure becomes, for all practical purposes, a stable and permanent one.

It is nevertheless necessary to base the study of constitution on conditions of true equilibrium. It is only under such conditions that the constitution of an alloy is definite. The equilibrium conditon is the condition which is approached as a limit when opportunity for atomic rearrangement is given by slow cooling or prolonged annealing. It is the standard from which actual conditions are to be considered as departures of variable and indefinite extent.

From this chapter on alloys, the authors proceed logically through structure and properties of aggregates, concluding with a summary of the evidence bearing on the nature of hardened steel, together with their views regarding the causes of hardness.

Profusely illustrated with photo-micrographs, curves and essential tables, the volume affords a mine of information not otherwise readily accessible. McGraw-Hill are the publishers.

Pittsburgh Welcomes Iron and Steel Engineers

Unusual Attendance Marked the Convention and Exposition Held by the A. I. & S. E. E.

THE Nineteenth Annual Convention and Exposition of the Association of Iron and Steel Electrical Engineers, was held at Pittsburgh September 15 to 19, and demonstrated the progress that has been made in the electrical and mechanical fields the last year. The electrical displays were exhibited in Duquesne Garden, while meetings of the organization were held in the William Penn Hotel.

At a meeting in the hotel Tuesday, L. A. Umansky of the General Electric Company, Schenectady, N. Y., spoke on "Adjustable Speed Sets for Rolling Mills," and E. G. Bailey of the Bailey Motor Company, Cleveland, delivered an address on "Combustion Control."

Displays Are Numerous.

All the iron and steel centers of the country had exhibitors on display. There were 155 booths at which all the achievements of not only last year, but of the last 18 years, are being displayed.

One of the interesting displays showed the great elasticity of steel. A small steel ball is shot into the air and rebounds on a flat steel disc.

The women who attended the convention were entertained by the Westinghouse Electric & Manufacturing Company at the Pittsburgh Country Club Tuesday afternoon. Wednesday they were entertained at the Shannopin Country Club by the Duquesne Light Company and the West Penn Power Company.

Wednesday was "Electrical Heating Furnace Day." Lectures were delivered by E. A. Hurme of the Westinghouse Electric & Manufacturing Company, C. F. Cone of the Hagan Corporation of Pittsburgh, J. A. Seede of the General Electric Company of Schenectady, E. D. Sibley of the Metropolitan Edison Company of Reading and R. S. Sawdey of the Van Dorn Iron Works of Cleveland.

A. C. Cummins acted as chairman of the general arrangements committee, being assisted by A. C. Dyer, R. B. Gerhardt, J. R. Doyle, A. R. Jones and G. W. Quentin.

Prominent Steel Men Deliver Addresses

The dinner of the Association of Iron and Steel Electrical Engineers, the climax of a four-day exposition and convention commemorating the thirtieth anniversary of the application of electric motors in the manufacture of iron and steel, was held in the William Penn Hotel Thursday night. Addresses were made by men prominent in the iron and steel industry, or the engineering phase of it. R. S. Shoemaker, president of the association, presided, while L. H. Burnett, assistant to the president of the Carnegie Steel Company, was toastmaster.

Homer D. Williams, president of the Carnegie Steel Company, reviewed the period and narrated the important steps taken by the introduction of electricity into steel making, recalling the first installations in the Homestead works. A. W. Thompson, president of the Philadelphia Company, explained the phenomenal growth of the central power system, asserting that during the past year 71 independent power plants dismantled, on the basis that the power from the central system was cheaper.

Other speakers were E. J. Buffington, of Chicago, Harry P. Davis, vice president of the Westinghouse Electric & Manufacturing Company, Mayor William A. Magee, and A. C. Cummings.

The officers for the coming year were elected at the business session; they are A. C. Cummings, president; George H. Schaeffer, and S. S. Wales, vice president; James Farrington, treasurer; F. W. Cramer, secretary; and W. S. Hall, G. R. McDermott, A. J. Standish, directors.

Convention Activities

In connection with the convention, G. L. Crosby, sales manager of the Roller-Smith Company of Bethlehem, Pa., held a miniature sales convention in the convention hall. The sales campaign of the company for the ensuing year being discussed. Those who attended the miniature convention were H. E. Ransford of Pittsburgh, who is in charge of the company's exhibit; George Peikson of St. Louis, Mortimen Frankle of Chicago, J. E. Wood of Cleveland, W. D. Merewith of Buffalo, and Joseph Esherick of Philadelphia.

The Exposition just closed proved one thing conclusively: Pittsburgh is the center to which the thousands interested in steel mill problems and progress will surely gravitate.

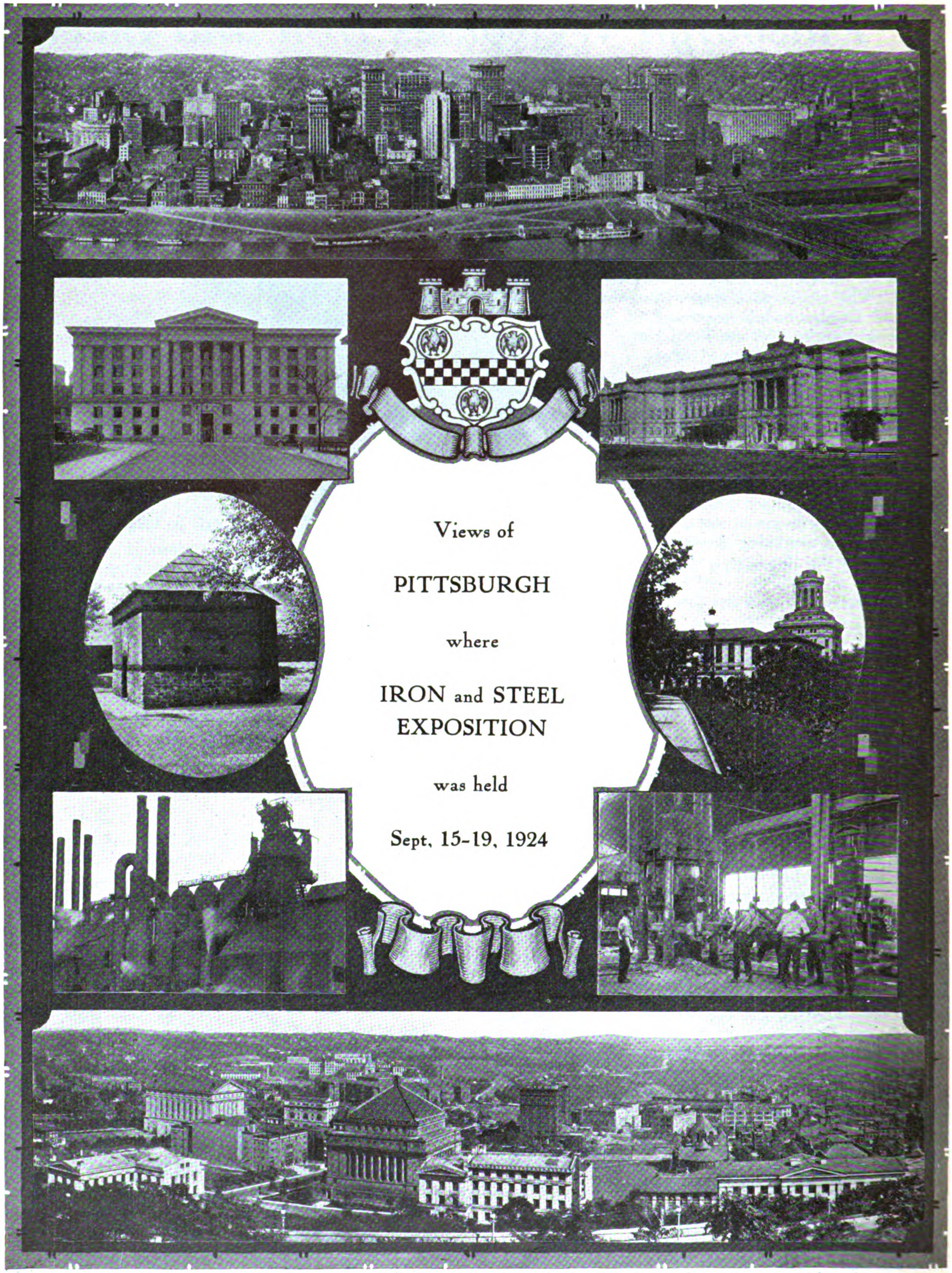
The end of a week's show usually finds the exhibitors, or those who are charged with the responsibility of demonstrating their companies' exhibits a tired lot of individuals. Last week was no exception in that respect, but in another most vital respect there was a difference; all were happily tired; they seemed to feel that their efforts were fully rewarded by the keen interest plainly shown by the thousands of visitors who thronged the aisles and crowded about the booths.

Not mere curiosity seekers were there; the method of admittance by ticket only guaranteed a quality of attendance seldom approached at industrial expositions.

Even though this convention lacked the spectacular individual quality furnished in 1923 by the Electrified Foundry, under the management of the Pittsburgh Electric Furnace Company, the generally interesting features seen at all the booths furnished a fund of sum total knowledge not soon forgotten by those who observed.

To describe them all is an impossible task, but to fail to call attention to at least a number of those outstanding would be equally unfair.

The Ohio Electric & Controller Company, Cleveland, O., was represented by F. W. Jessop, Paul H.



Views of

PITTSBURGH

where

IRON and STEEL EXPOSITION

was held

Sept. 15-19, 1924

Diver and R. O. Werty of Cleveland, and Chas. H. Murdo, Pittsburgh; W. H. Williams, Chicago; L. O. Morrow, Philadelphia, and R. Horne, Detroit, representatives and associate members of the A. I. & S. E. E.

The exhibit consisted of typical pictures of Ohio Magnets at work, and an exhibit of magnet parts especially illustrating the insulation of the various members, important because the useful life of a magnet is measured by the life of its insulation.

The new Ohio Magnet Controller was shown in action consisting of the fewest possible number of parts required to close the circuit, break it with a small harmless arc and reverse the circuit through limiting resistance to drop the load quickly.

As long as the magnet is connected to this controller there is a resistance across its terminals (regardless of the operating position) to absorb the enormous pick voltage induced when the magnet circuit is broken.

This important feature reduces the arc, protects the insulation of the magnet and also that of any other motor or coil connected to the same system. It is essential for safety of men as well as machinery.

The resistance used is Cromalox strip worked warm but capable of working red hot. The operating coil can stand across full line voltage continuously. The four contacts are uniform and easily made. The arc shields can be lifted up about a hinge to get at the contacts.

Magnet controllers have given a lot of trouble hence this one which occupies but little space was examined critically and approved by a large number of operating men attending the convention.

Among the Exhibitors.

The Nichols-Lintern Company, Cleveland, Ohio. This company exhibited the improved Lintern Electro Magnetic Sander, which is now furnished with a heated air chamber which provides that the condition of the sand will be such that it will respond quickly and easily. They also exhibited their new line of Universal signal lanterns, which they feel is complete, and that there is a Universal for every need.

Cutler-Hammer Manufacturing Company. This company placed before the steel mill electrical engineers attending the convention a new reversing full magnetic mill controller of the inductive time limit type. The functions of the controller on exhibiton were fully demonstrated in connection with a Crocker-Wheeler 25-hp., 220-volt. d.c. motor. A flywheel and friction load is provided to stimulate the load characteristic of a roll table. Meters are provided for indicating currents taken by motor under varying accelerating conditions. The controller is of exceptional interest in that time limit acceleration is provided without the use of dashpots or electro-mechanical devices and auxiliary contacts have been practically eliminated. The exhibit controller, which is of standard design, shows clearly a simplicity of construction that has not heretofore been obtained with this type of control apparatus for steel mill operation.

Duquesne Light Company and West Penn Power Company. "Live in and Expand Your Business in Greater Pittsburgh." The growth of the Pittsburgh District has been closely connected with the development and expansion of its public utility companies furnishing light and power. That these companies may more ably serve the district and be ready to meet the increased demands of this great community rapidly growing greater, power stations are constantly being enlarged, new equipment purchased and more lines and cables laid for the distribution. All along the line additional equipment is being installed as the scope of the service broadens.

In order that the visiting officials, engineers and their friends attending the Iron and Steel Exposition at the Duquesne Gardens, Pittsburgh, Pa., may more fully realize the magnitude of the service being rendered, one of the largest central stations, Colfax, convenient to Pittsburgh, and the new heating boiler, fired with Lopulco system were open for inspection of visiting engineers.

Johns-Manville, Inc., Chicago, Ill. This company displayed samples of various forms of insulation, roofings, waterproofing, electrical and power specialty materials, and possibly some new forms of high heat insulation. They unanimously report greater interest by potential buyers than ever shown at any previous exposition.

Bacharach Industrial Instrument Company, Pittsburgh, Pa. To assist the combustion engineeer in his efforts to produce good uniform material with a minimum amount of fuel, many different kinds of industrial instruments have been designed and are being manufactured. The efforts of this company have been to manufacture industrial instruments which will produce the desired results dependably and with the least amount of attention. A number of these instruments were exhibited and included the Hydro Low Pressure Recorder for measuring gas and air pressure the Hydro Volume Meter for recording flows of gas and air; the Hydro Pressure Volume Recorder for convenient comparison of volume and pressure; the Bacharach Manometers for indicating pressures and volumes of gas and air; the Universal Draft Indicator for measuring low pressures on a magnified scale; Pitot tubes and orifices to meet almost any conditions; Bacharach electric CO_2 and CO meters for controlling combustion and furnace atmosphere; the Maihak Engine Indicator for setting valves and determining power of reciprocating engines, including the internal combustion class; the Bacharach Pyrometers for controlling temperatures, and Standco megohmers for measuring electrical leaks through insulation.

Those in attendance included Messrs. E. J. Strauss, J. A. Stein, L. Vayda and Mr. Danks, of Cleveland.

Westinghouse Lamp Company. This exhibit consisted of a complete line of incandescent lamps used for lighting industrial establishments and iron and steel mills. Some of these exhibits showed in a very interesting manner lighting effects obtained under clear and frosted lamps. Shadow effects and the ruggedness of particular types of incandescent lamp, where subject to extreme viriation, was also featured. Industrial types of reflectors was shown and the process of manufacture of there reflectors was detailed.

Vulcan Soot Cleaner Company. The valve operating soot blower head exhibited in this booth was in charge of Mr. Fred W. Linaker, vice president of the Vulcan Soot Cleaner Company, together with Mr. John D. Hiles and Mr. Short of the John D. Hiles company, their Pittsburgh representatives.

The Vulcan self-contained soot blower head differs from all others in that the valve is an integral part of the head and is closely associated with the cleaner element, so that the valve and rotatable element are operated by one operating handle or one chain. The valve disc portion consists of a swinging valve disc. It is self-grinding, positive in action and cannot be held away from the seat by any dirt or grit on either the seat or the disc. It can be seen in actual service on the largest horizontal water tube boiler in the world (the 3,000-hp. boiler in the Cecil Plant of the Allegheny County Steam Heating Company, Pittsburgh, Pa.).

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This company had on exhibit at their booths an entirely new line of d.c. magnetic controllers, designed especially for heavy duty steel mill service. The latest design of type C form BB magnetic controller, which is devised for plugging service, was connected to an 80-hp. type MC motor and controlled by a new type of foot-operated master switch. This was shown in actual operation. A type C form MB controller, which is a new form, was shown with the latest design of two-point master switch.

The new design type C form DD controller, which provides dynamic braking in the off position, was exhibited in operation with the new design of four-point master switch in connection with an 80-hp. type MC motor. The new type C form EE controller, which is for hoist duty with dynamic braking lowering, was shown on the exhibition floor with its latest design of crane hoist master switch.

A new form of controller, known as the type C form MD, was exhibited for the first time with the latest form of type MM or "pan cake" master switch. This is a non-reversing type of controller which provides dynamic braking in the off position.

The controller exhibit was completed with a display of the latest design of crane protective panel, which includes some new and exclusive protective features.

Several different sizes of the well known type CS motor were shown. Several improvements that increase reliability were included.

An interesting feature of the exhibit was a demonstration outfit which will show type LV lightning arresters in actual operation. Miniature lightning discharges were produced and the demonstration outfit showed how the excess line voltage produced by these discharges are dissipated by the arrester. A large type SV arrester was shown.

Micarta, the material of endless possibilities, was displayed in such a way as to show some of the many forms in which it can be produced.

Safety knife switches were shown in many forms and capacities. A heavy duty type, with new design arc quenchers, being built especially for steel mill service was displayed.

A number 2 MDA turbine and a 7½ -kw. turbine generator showed the latest advances made in the steam turbine field.

All the d.c. power used by exhibitors was furnished from a 300-kw. Westinghouse automatic sub-station. The Duquesne Light Company furnished 2200-volt, 3-phase, 60-cycle power from a transformer sub-station outside the exhibition hall to the 432-hp., 1200-rpm. motor which drove the generator. The switching equipment was of the full automatic type, protecting the motor generator against all kinds of overload or overheating and shutting down the outfit when there was no demand for current.

SKF Industries, Inc., New York, N. Y. In the exhibit of this company a range of Skayef self-aligning and Hess-Bright deep groove ball bearings and Atlas balls were shown along with interesting models which will bring out the anti-friction qualities of ball bearings. A large ball and roller bearing, such as used in steel mill applications, shown and suitable blueprints of steel mill mountings.

Square D Company, Detroit, Mich., showed the Square D 80000 series, the switch which has excited such favorable comment by industrials ever since its development. Demonstrations of the two much talked of features—the individual base construction, by which switch parts can be removed from the front of the switch in a few minutes' time, and the cover control with the key. The 76000 line of straight connected, quick make and break, single throw motor starting switches were also on display.

Standard Underground Cable Company, Pittsburgh, Pa. This company exhibited samples of various types of bare and insulated electric wires and cables for aerial and underground service, also samples of outdoor and indoor cable terminals and cable junction boxes. A feature of the exhibit was a demonstration of joint making on lead covered underground cables.

William Swindell & Brothers, Pittsburgh, Pa., showed representative installations of its line of electric furnaces. Arc type melting furnaces for iron and steel were shown including both the single type and the multiple type, the latter being the newest development in the electric melting field. Electric heat treating and annealing furnaces of various forms were shown. These are of the metallic resistor type equipped with automatic temperature control.

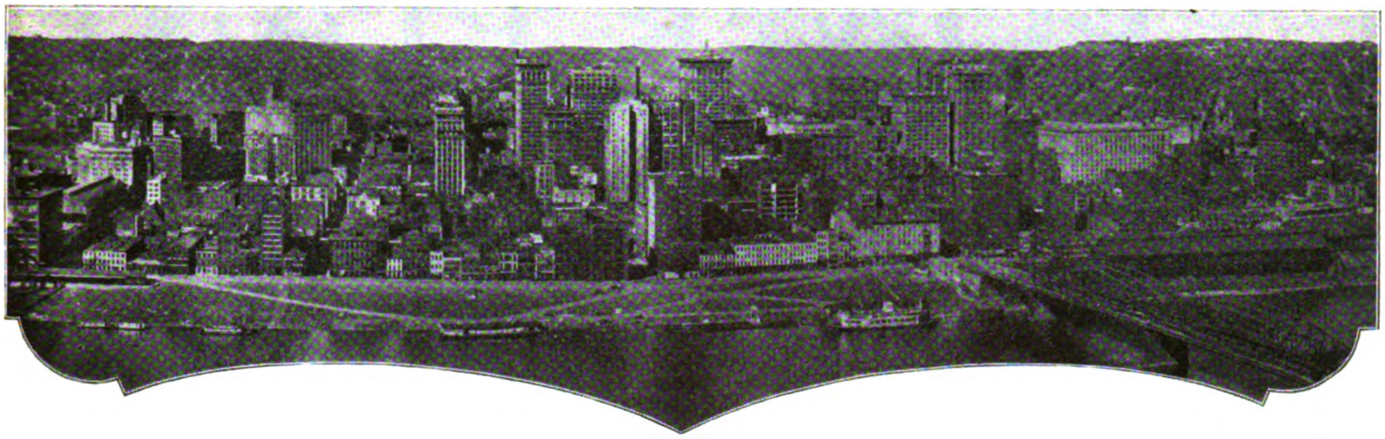
Stroh Steel-Hardening Process Company, Pittsburgh, Pa. This firm covers an extensive range of manufacture having diversified clientele in blooming mills, rolling mills, cement, lime and brick plants, mines and collieries, foundries, industrial works, quarries and gravel pits. This makes it possible to exhibit only a limited application of the Stroh Process which is a method for casting the finest alloy steel together with ordinary soft steel in one solid piece The resultant casting has a wearproof alloy steel stratum upon the wearing surfaces, while the body is composed of any desired steel and is in no way affected. The hammer formed and hammer finished crane track wheels exhibited have the flanges and tread of Stroh Alloy giving over four times the life of other wheels, the flanges cannot break and the tread is designed for ultimate wear and hardest mill service.

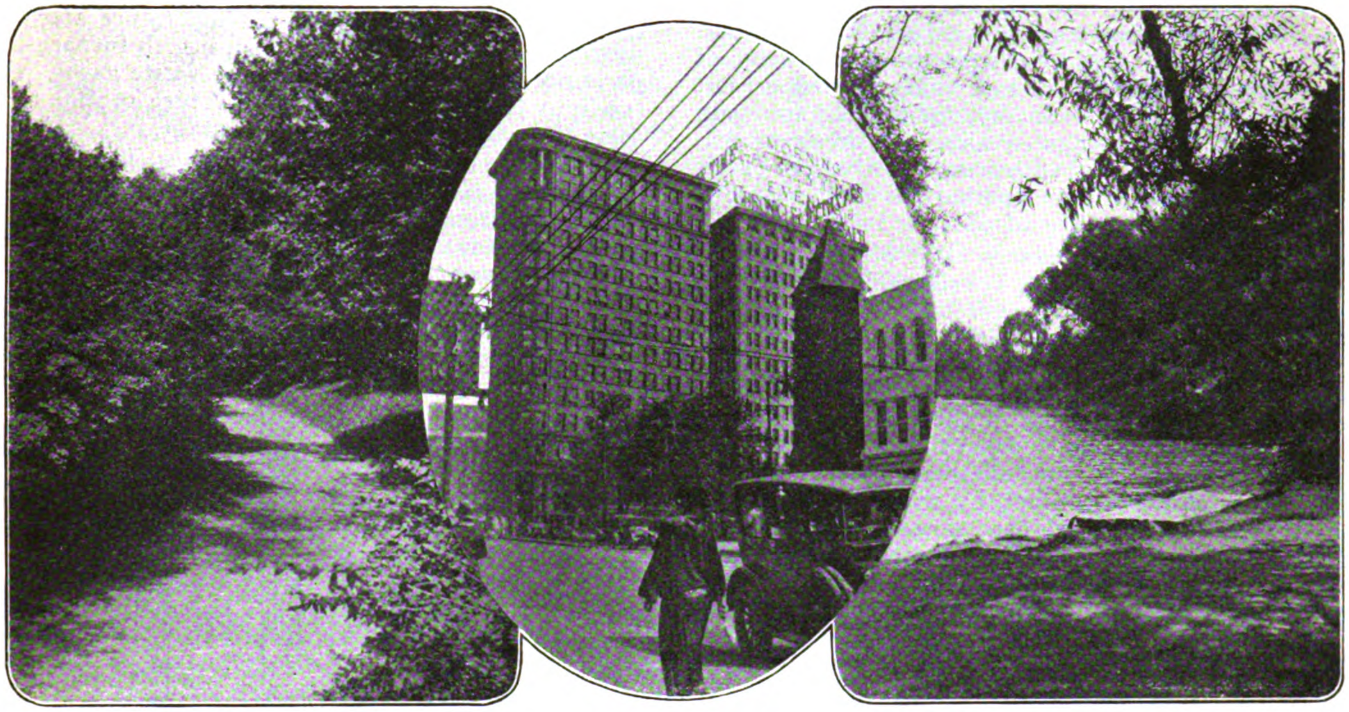
Keystone Lubricating Company, Philadelphia, Pa., showed their complete line of lubricants with photographs of installations of the Keystone safety lubricator. This system is being generally adopted by the steel industry, not only for cranes and ore bridges, but also for boring mills, mill tables, levelers, upsetting machines and other units, and it is recognized as the most improved safety feature in present day lubrication methods.

There was on display the Keystone converter cup, through the use of which this safety lubricating system is made automatic and kept under constant pressure.

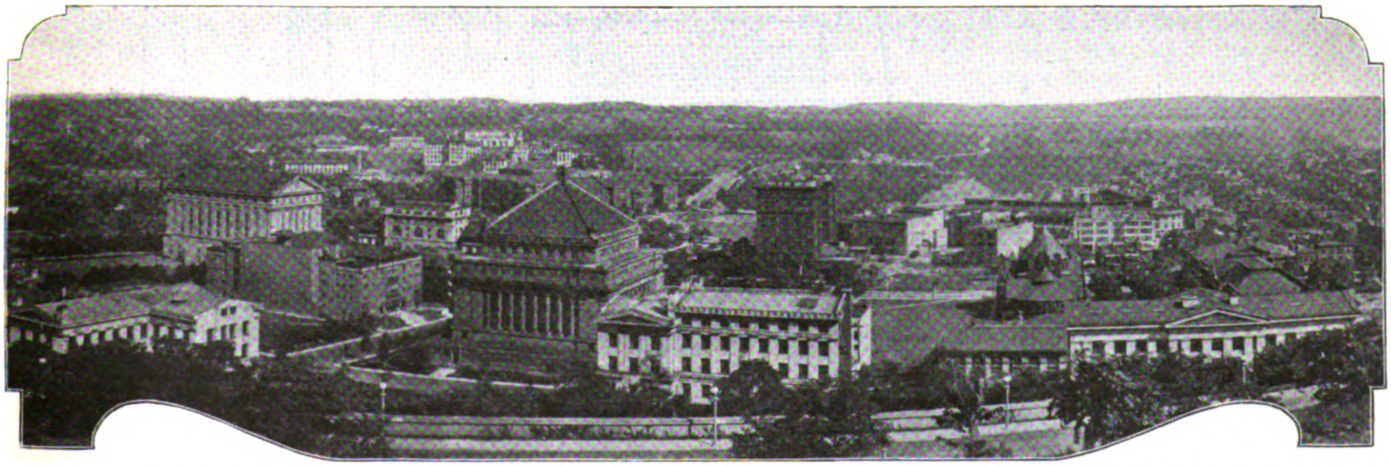
(Continued on page 479)

Pittsburgh Entertains Iron and Steel Engineers





Pittsburgh's parks abound in natural scenery. Insert—A section of East Liberty's shopping district.



Pittsburgh's "Civic Center", considered one of the most remarkable in the country, where are grouped the buildings of a dozen institutions, schools and organizations.

The POWER PLANT

Experiences With Waste Heat Boilers Behind Open Hearth Furnaces*

By WILLIAM SCHUSTER DONAWITZ
Translated by F. Illies†

IT is natural that metallurgical furnaces, which need high temperatures, also possess high waste gas temperatures, and this is especially the case at furnaces which work without or with small heat stores. But even at regenerator furnaces an enlargement of the chambers above a certain dimension does not bring about a greater economy, for the larger regain of heat in the chamber is equalized by greater radiation losses. Also, further increase of the gas or air preheating and with it the combustion temperature is limited by the durability of the fire bricks.

Under these circumstances most of the metallurgical furnaces work with considerable waste gas loses. At furnaces with regenerators 30 to 35 per cent of the employed heat goes with the waste gases into the stack at heating and puddling furnaces. Without recuperators this loss increases to 70 per cent. This has led to the employment of the waste gases under boilers, but the efficiency is not very large, as the heat transmission does not take place by radiation but by the less effective contact, by which large and expensive heating areas are necessary. The heat transmission can be increased by the following means: Good circulation of the water in the boiler; increase of velocity of the gases; clean heating surfaces, and by whirling the waste gases in order to get a good contact with the heating surfaces. In spite of these measures, the steam generation is only then economical when the waste gases have a temperature above 450 deg. C. This is the case at open hearth furnaces, and it is peculiar that till recently the waste gases, which go into the stack with a temperature of 500 to 900 deg. C., were not turned to advantage.

This is probably due to the proved fear of an unfavorable reaction on the rather sensible furnace operation, troubles of production at boiler reparations, and limitations of freedom of motion are perhaps to the bad experiments which are made with waste gas boilers behind tilting furnaces, as the slit between furnace and head decreases naturally the waste gas temperatures.

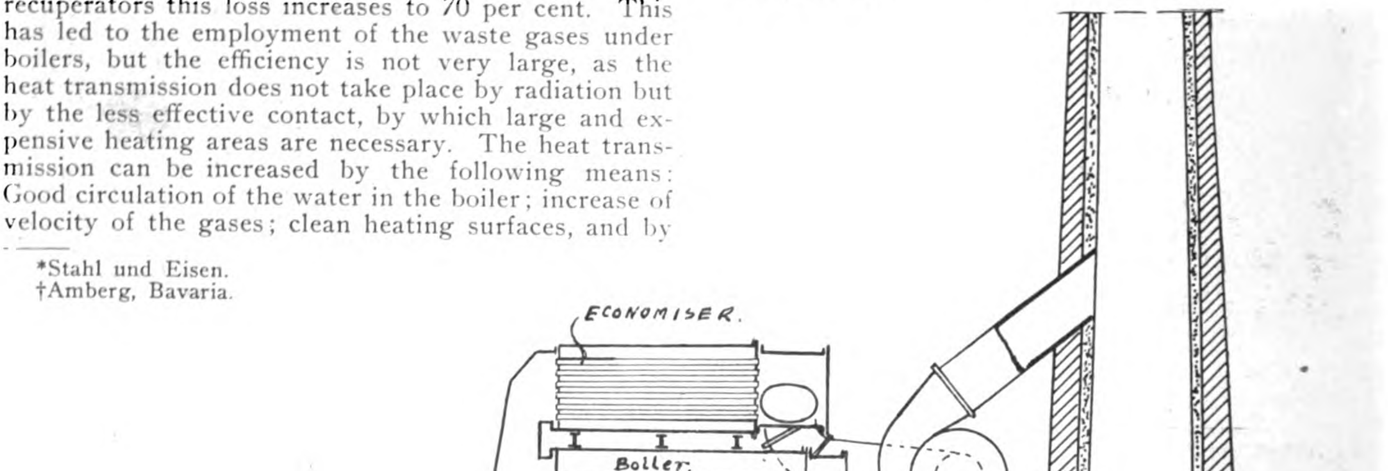


Figure 1. Waste heat boiler of the M. A. N.

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*Stahl und Eisen.
†Amberg, Bavaria.

But the fears in regard to bad furnace operation and break-down of the boiler during the operation, can almost entirely be annulled by right construction and by the principle that the boiler operation has to be directed as much as possible to the operation of the furnace.

As the place behind the furnaces is mostly very narrow, water or smoke tube boilers can be used. At the Donawitz Steel Works, three different kinds are tried. One of them consists of three waste gas boilers of the Brunner Machine Company, A. S., which are put into a parallel circuit. Each one possesses a cylindrical upper and lower boiler, connected by vertical water tubes of 745 square feet heating surface. The superheater has an area of 468 square feet and the economizer of 1,277 square feet. The waste gases go first through the three boilers, then through the superheater and at last through the economizer, are sucked off by an exhauster and pressed into the stack. The waste gases have also a direct connection with the stack.

The second boiler is furnished by the Hanomag, Hanover. The waste gases go at first through the superheater of 548 square feet, go up and down through the boiler of 2,128 square feet, heating surface, and at last through the economizer of 1,532 square feet heating surface. The latter can be quite or partly put out of the circuit. An exhauster is also provided. The third boiler has a superheater before the boiler of 585 square feet; the boiler has 2,980 square feet and the economizer 2,128 square feet heating surfaces. Boiler setting as well as superheater are amply provided with explosion lids, which open at occurring explosions during reversing. The experiences with these boilers are as follows:

The exhauster was so regulated that the draft behind the Forter valve remained the same as formerly, so that the furnace operation was not suffering any change. It was, however, difficult to keep the draft on the same height, as through small slits in the brickwork at an under pressure of 1⅜ to 2⅜ in. W.G. considerable quantities of false air enter the flues. Not only the efficiency of the boiler but also the draft behind the Forter valve is deteriorated by this. A good effect had a cover of tar on the outside of the brickwork. An advantage have the boilers without brickwork, f. i. the boilers of the M. A. N. (Maschinenfabrik Augsburg-Nurnberg.)

A further circumstance, which influences badly the draft behind the furnace, is the accumulation of dirt in the flues and as the furnace needs more draft at the end of a melting period, it is advisable to choose a rather large exhauster with speed regulation.

The boiler efficiency depends naturally upon the temperature of the waste gases and varies considerably during a melting period. Also the daily steam production is depending upon the operation of the furnace. Therefore, those mills which work only with waste gas boilers must keep one or two boilers for coal firing. Distinctly recognized is an increase of the evaporation at the end of a melting period in consequence of higher temperatures of the waste gases on account of worse efficiency of the dirty heating chambers. It is the rule if the furnace works satisfactorily the boiler does not, and reverse.

The steam production amounts to 200 to 230 lbs. per ton of steel, while 45 to 55 per cent of the furnace heat is regained, or 15 to 17 per cent of the generated steam is again needed for the exhausters at electrical drive. Steam driven turbo-ventilators are more economical.

The situation of the superheater behind the boiler is not to be recommended, because the temperature of the waste gases is too low to secure a sufficient superheating. In placing the superheater before the boilers, it has to be observed that the normal relation between boiler and superheater surfaces cannot be applied to this arrangement, as the superheaters are exposed to higher temperatures than at the normal steam boiler operation. The superheating amounted up to 520 deg. C. and the tubes became dark red. Therefore, the surface was reduced from 548 to 70 square feet in the second case and from 585 to 400 square feet in the third case. Generally the superheating should be one-tenth of the boiler heating surface. The superheater should also be placed so that it can be put out of operation in order to clean it or effect repairs.

The deposits on the heating surfaces were very troublesome. These consisted mainly of metalloxides as oxide of zinc, dioxide of tin, lead oxide of scale and ore dust, which at a normal open hearth furnace go into the stack, while they deposit on the cooler boiler surfaces. At the higher waste gas temperatures about at the end of the melting period, these depositions burn together and can only be removed by chisel and saw. Especially troublesome are the deposits, when tinned or galvanized iron sheets are charged, so that it is of great advantage to melt this kind of scrap in furnaces without waste gas boilers.

The economizers suffer largely by the high content of water vapors in the waste gases, originating from the steam, blown into the gas producers and the water seal of the Forter valve. Especially dangerous is the sulphur content of the waste gases in case the outer temperature of the economizer lies deeper than the thawing point of the waste gases. The tubes cover themselves with water, which combines with the sulphuric dioxide of the gases to sulphuric acid and creates heavy corrosions.

The following table gives evaporation trials on the three boilers:

The experiments made with the water tube boilers show that an addition of 50 to 60 per cent false air cannot be avoided. For this reason it has been resolved to abandon water tube boilers and introduce the boilers of the M. A. N. (Fig. 1) with smoke flues, which are practically air tight. The superheater before the boiler has a heating surface of 276 square feet, the boiler of 2,607 square feet, and the water preheater, which is situated above the boiler, of 1,503 square feet. The superheater can be lifted out of the flue in case of repairs. The water is preheated by the exhaust of the turbo-feeding pumps to 80 deg. before entering the economizer, so that corrosions are avoided.

A 27-page bulletin on Automatic Station Control Equipment has recently been issued by the General Electric Company and is designated as No. 47731. It describes briefly the uses and advantages of this type of equipment, and is well illustrated. The greater part of the bulletin is given over to a list of installations up to January 1, 1924, giving the name of the company, station, type of apparatus, kilowatt capacity and incoming and outgoing voltage.

Great Clearing House of New Information

Pittsburgh Will Send an Unusually Large Delegation of Operating Men to New York Gathering

THE National Exposition of Power and Mechanical Engineering is now well established as the great annual clearing house of information concerning new developments in appliance for the generation and utilization of power. The Third Annual Exposition will be held in the Grand Central Palace, New York, December 1st through 6th, 1924, and will parallel the annual meetings of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers.

In a country depending upon power for its strength and growth it is only natural that a power show should flourish. Since man changed from a tool-using to a tool-controlling animal his demand has been for power and increasingly more power. The industrial supremacy of America is traced by many engineers to the fact that there is more installed horsepower per workman in this country than in any other country. Furthermore, the relation between the wage rate of one country to the wage rate of another is the same as the ratio of available horsepower in the two countries. The American workman is paid twice as much as the British workman because he directs twice the horsepower. In a time when the power demands of our metropolitan centers are doubling every 10 years, when a power station built six months ago is out of date today, when all power engineers are straining every effort to seek out most economical methods of burning fuel and of generating and using power, an exhibition like the power show fills an important place in our scheme of existence.

The facts that at the present time the coming show has twice the requests for space that the previous show had at a corresponding time last year, that the attendance last year increased 30 per cent over that of the year before and that engineers and manufacturers all over the country are now making their plans to be present at the coming event, are definite proofs that its success is assured.

The importance of power in the development and maintenance of our civilization is not generally understood. It is true that the popular magazines and the daily press speak frequently of it, but the diversity and complexity of the problems involved in power development and utilization can only be thoroughly appreciated after a visit to an exhibition such as can be found at the Grand Central Palace the first week of December.

The Power Show is looked upon as the great opportunity for comparing competitive products, for permitting actual contact with new appliances and the organizations that supply them, and as a place where buyers may receive expert advice from many manufacturing concerns in regard to money-saving equipment. The constant struggle for improvement furnished the necessary stimulus to commerce and industry, and an exposition which reveals new ideas, their uses and limitations is an important help in the struggle.

The managers of the exposition are Fred W. Payne and Charles F. Roth, whose headquarters are in the Grand Central Palace, New York, N. Y.

Theory of the "Benson" Super-Pressure Steam Generator

IT will not be without interest, following upon a previous article in Chemistry and Industry (March 7), to consider a little more in detail the scientific principles underlying the design of the remarkable "Benson" super-pressure steam generator, in which water is converted into steam without the absorption of latent heat under the critical conditions of approximately 3200 lbs. pressure per sq. in. and a temperature of 706 deg. F. (375 deg. C.).

As will be remembered, the installation consists of a series of coils of ¾ in. steel tubing arranged vertically, through which distilled water is being passed continuously at 3200 lbs. pressure by means of a gear-driven force pump. The coils are heated by an oil or pulverized-fuel flame blast, using hot air for combustion, and towards the end of the travel the water attains a temperature of 706 deg. F. (375 deg. C.), and is bodily converted into steam without ebullition or boiling, and therefore without the absorption of latent heat. The steam is then discharged at a slight superheat 720 deg. F. (385 C.) through a reducing valve, being thereby reduced in temperature to about 620 deg. F. (330 deg. C.), and into a second series of coils forming a superheater, in which it is heated to an average of 850 deg. F. (455 deg. C.), and finally discharged at this temperature and 1500 lbs. pressure to the turbine or other source of use.

The essential reason underlying the design of the "Benson" generator and the employment of 3,200 lbs. pressure is to obtain on a practical scale very high pressure steam with the aid of the coil generator or "boiler". The elimination of latent heat in itself does not result in any higher efficiency in the condensing turbine, the heat being of course lost in the condenser just the same. That is to say, the increase in theoretical efficiency to be obtained by using steam at 3200 lbs. pressure, as compared with say 2750 lbs., is very small. The practical difference, however, is enormous, because in the first case no latent heat of steam is required and a coil generator can be used, whereas in the second case the latent heat of steam is about 290 Btu. (from 1 lb. of water at 32 deg. F.), so that ebullition or boiling accompanies the generation of the steam, and a coil generator consequently is not practicable.

The main difficulty with the use of high-pressure steam has always been to construct a boiler to stand the conditions, and 127 years of evolution—since 1797 when Richard Trevithick invented the "Cornish" boiler, worked at 25 lb. pressure—has only resulted in the average industrial steam pressure being today, say, 100—160 lbs., ordinary power station pressures 160—220 lbs., and the modern super-power station 350 lbs. Whilst a few water-tube boilers are now constructed to work up to about 600 lbs. and even 800—1200 lbs. as an experiment, for several thousand pounds pressure it is necessary to use narrow bore coils to reduce the area that has to stand the strain, and incidentally also to eliminate the element of danger by having an extremely small water content. A steel tube can be constructed to stand thousands of lbs. per square inch pressure, and the present "Benson" generator was put on hydraulic test by the insurance company to 6500 lbs. per square inch for 20 minutes without a trace of leakage.

But the absorption of latent heat has hitherto proved an insurmountable obstacle to the use of the coil generator, because particles of liquid (water) are converted into comparatively large bubbles of gas (steam) of much greater volume, so that in a narrow bore coil the whole water contents are blown out. Mr. Benson has solved this problem by a thorough consideration of the properties of steam. As the pressure rises, the latent heat, which is 966.6 units under atmospheric conditions, diminishes, since the change in volume between water and steam becomes less and less. The ordinary steam tables do not show this as they seldom go above 250 lbs. pressure, and it is necessary to study some publication such as Goodenough's "Properties of Steam and Ammonia" (John Wiley or Chapman and Hall). The following typical figures illustrate the reduction in the latent heat as the pressure rises:

(1 lb. Water at 32 deg. F.)

Absolute pressure lb. per sq. in.	Saturated Steam Temperature, deg. F.	Sensible heat from 32 deg. F.	Latent heat Btu.
114.9	338	308.5	882.2
361.6	435	411.4	791.2
538.7	475	455	745.8
1093.0	550	541	644.8
1785	620	633	518
2360	660	700	412
2880	690	776	280
3075	700	820	198
3200	706.3	921	Nil

Mr. Benson has therefore completely solved the problem by going right up to the critical conditions when no latent heat at all is required, since the steam is at the same volume as the water (three times that of 60 deg. F.), and therefore no ebullition takes place. Once steam is formed, and what is the essential difference between a liquid and a gas is outside the scope of this article, then we can do what we like in the way of superheating or reducing the pressure.

To calculate the amount of the increase in thermal efficiency by raising the steam pressure to 1500 lbs. or over is a complicated question, and it is best obtained from a series of Rankine cycles plotted for different pressures at constant total heat of steam on temperature entropy diagrams, both of course under adibatic (or theoretically perfect) expansions. Thus taking a total heat of steam at 1350 Btu. calculated from 32 deg. F., and superheating as required to attain the given total heat, at 100 lbs. pressure only 400 Btu. (29.6 per cent.) is theoretically available for actual work in expanding down to a vacuum (29 in.), whereas at 350 lbs. the figure is 468 Btu. (34.7 per cent), and at 3200 lbs. 595 Btu. (44.0 per cent).

Practically, of course, there is a considerable loss for various reasons, but the matter can be concisely expressed by saying that the ordinary high-class industrial steam engine or turbine is running at 10—11 per cent thermal efficiency from the coal, the most modern super-power station 17—19 per cent (an exceptional figure), whereas a large "Benson" generator plant would give 28—30 per cent, an amazing advance. In other words, we can now generate power from raw coal, using a condensing unit and pulverized fuel for heating, at an efficiency equal to the Diesel engine with oil, and the principle is equally revolutionary applied to land, marine, locomotive and motor-car work. In addition, the use of the exhaust steam from the turbine in boiling and process work, as in the chemical industries, would apparently give an over-all thermal efficiency of something like 80—85 per cent since no heat is lost in the condenser.

Power Plant Refractories Survey

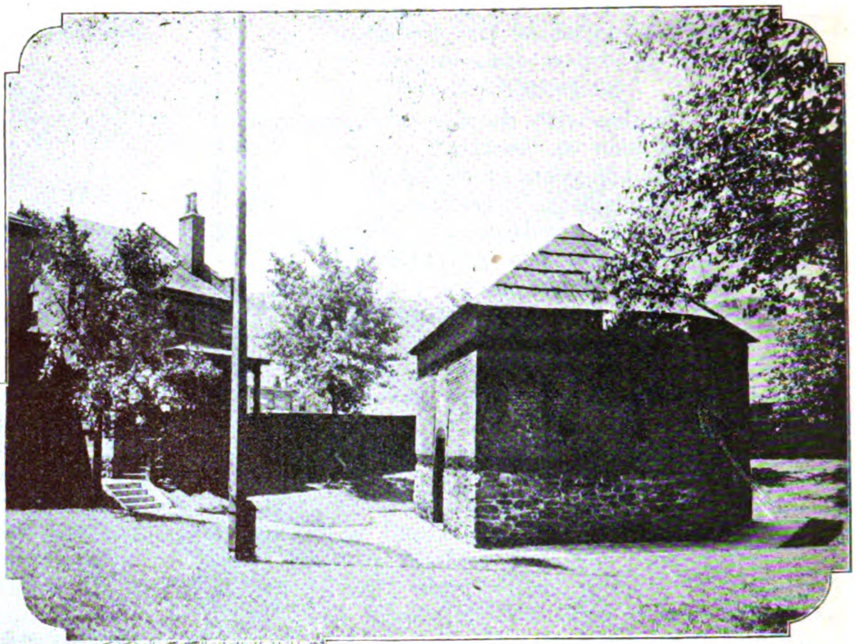
A co-operative agreement has been made between the Department of the Interior and C. A. Hirshfield of Detroit, representing a group of large central power plant operators, to make a survey of present conditions relating to the use of power plant refractories. The survey will be conducted by engineers of the Bureau of Mines.

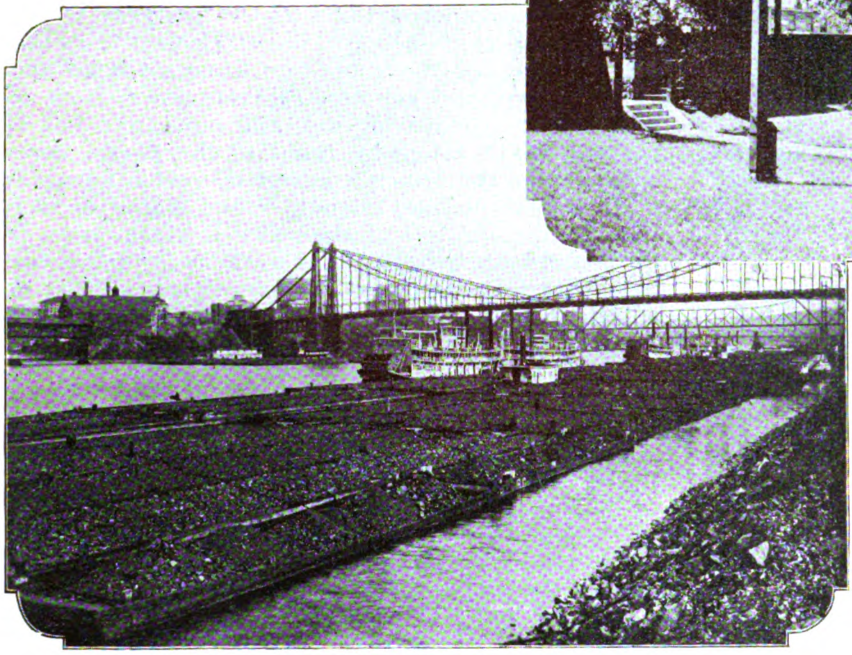
With the present high ratings at which boiler plants are being operated and the increasing use of pulverized coal with its attending high temperatures, the refractories now available for lining boiler furnaces are proving inadequate. In this survey a study is being made of the characteristics of refractories now available for use in power-plant boiler furnaces, and the conditions under which they are used, their life in operating practice under the conditions prevailing at different plants and the way in which the refractories now marketed fail to meet these conditions. The purpose of the survey is to obtain fundamental data to be used in bettering refractory service.

Washing of Freeport Coals

A study of the washing characteristics of coal from the thick Freeport bed in Pennsylvania has been completed by Department of the Interior investigators working in co-operation with the Carnegie Institute of Technology. The tests were conducted at the Pittsburgh experiment station of the Bureau of Mines. Coal from this thick bed makes good metallurgical coke except that at some mines the ash content is usually too high, and at other mines sulphur is present in the coal in excess of amount permitted in metallurgical coke. Therefore, washing to remove the ash and the sulphur is an important and vexing problem to the coal-mine operators. The coal is mined for by-product coking, steam-raising, domestic use, gas-making and other purposes.

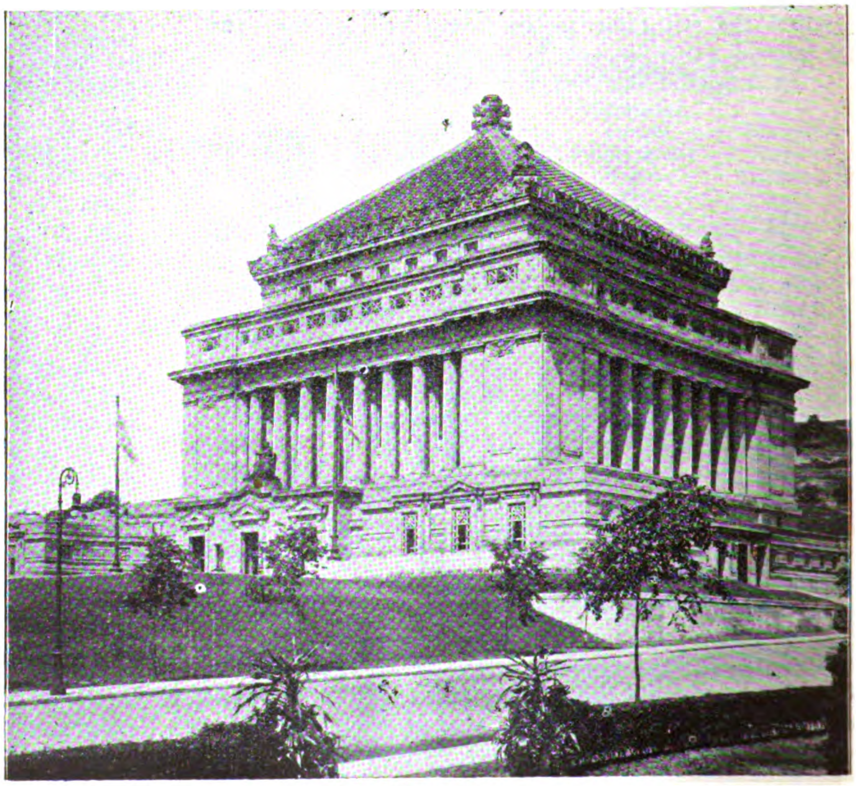
The old Block House built at the confluence of the Allegheny and Monongahela Rivers to protect the early settlers from the ravages of the Indians.





A typical scene at the Point today. Pittsburgh's river tonnage exceeds that of the world's four largest ports combined, averaging over 24,000,000 tons annually.

Soldiers and Sailors Memorial Hall



Equipments Shown at the Iron and Steel Exposition

CONVENTION ACTIVITIES

(Continued from Page 472)

They had samples of greases for open gears, for use in the Venango gravity cup system—also liquid greases for ring oil motor bearings, and densities for ball and roller bearings. Demonstrated on a hot plate the relative loss of viscosity of motor oil and liquid grease, showing the ability of the liquid grease to retain its density and non-creeping qualities under operating temperatures.

The General Electric Company, Schenectady, N. Y., as usual, had a very generous space allotment. Their exhibit included the following: 1 mill type (Type MD) motor complete with control; 1 polyphase and adjustable speed brush shifting 3-phase motor with operating switch; 1 small Sprague hoist; 1 steam flow meter; 1 small industrial type squirrel cage induction motor, and various kinds of control apparatus.

Probably the general public were most keenly interested in the unique demonstration of Fused Quartz—one of the most remarkable developments known to recent science. To observe a beam of light transmitted around corners in a solid glass tube is sufficient evidence of the intensity of research carried on by the General Electric.

Ludwig Hommel & Company, Pittsburgh, Pa., had on display apparatus manufactured by the Sangamo Electric Company of Springfield, Ill., the Wagner Electric Corporation of St. Louis, Mo., the States Company, of Hartford, Conn., and the Economy Electric Devices Company of Chicago, Ill.

A very interesting exhibit of the new Fynn-Weichsel motor shows the effect of the "motors that corrects power factor". A standard induction motor-generator set and a motor-generator set using the Fynn-Weichsel motor are arranged so that they may be operated separately or in parallel, and so that the load on either set may be varied. Instruments are mounted so that the effect of the different operating condition on the power factor of the supply circuit may be observed.

The new Sangamo horizontal two element polyphase watt-hour meter was displayed. One of these meters was so connected that it measured the total kwh. used by the Wagner exhibit. One of the outstanding features of the new meter is that by observing the speeds of the two separate discs the power factor of the circuit being measured may be easily and quickly determined. This meter further affords a quick and accurate check on the correctness of the meter connections, and as to whether from any cause one potential element or circuit may be open, a common cause of error in polyphase metering.

Aluminum field coils for street railway motors, crane motors, d.c. mill motors, etc., are rapidly proving their superiority to copper coils in their ability to stand up under severe service. A section of this new type of coil was shown and proved most interesting.

Hyatt Roller Bearing Company, Harrison, N. J. The Hyatt Roller Bearing Company exhibited a complete line of Hyatt bearings for steel mill equipment and for mill motors, with models illustrating the simplicity of applying Hyatt bearings to motors. Hyatt bearings mounted in glass, driven by small motors, visually demonstrated the positive oiling action.

American Engineering Company, Philadelphia, Pa. The "Lo-Hed" Mono-Rail Electric Hoists, which were on exhibition in Booth 159, have an exclusive feature that not only increases their utility on any material handling job, but also greatly increases their field of application. They are designed so that they operate in the minimum headroom; considerably less weight for capacity than any other hoist on the market. This is accomplished by having the hoisting drum on one side of the I-beam track and the motor on the other side—an arrangement which permits the load block to be drawn up inside the frame of the machine until it practically touches the under side of the rail. The construction of these hoists is exceptionally fine. Gears are of high carbon steel, drop forged. Roller bearings are used throughout. The mechanical efficiency is 80 per cent with a factor of safety of 5 at full load. Safety, accessibility and ruggedness are outstanding features. "Lo-Hed" hoists are made in capacities of from 1,000 to 12,000 lbs. There are five types (1, bolt suspended; 2, plain trolley, floor operated; 3, hand geared trolley, floor operated; 4, motor driven trolley, floor operated; 5, motor driven trolley, cab operated), all of which are available for either a.c. or d.c. operation.

Bartlett Hayward Company, Baltimore, Md. The equipment which the Bartlett Hayward Company exhibited consisted of a complete line of fast flexible couplings, showing sizes from 1-in. bore to 12-in. bore. In addition to this line of couplings, they exhibited also a very interesting machine developed by Mr. Fast for testing flexible couplings. This machine is arranged so that a load of 2,500 hp. can be developed on a coupling and will also give a practical demonstration of the oil film theory, by means of which they will be able to thoroughly demonstrate the fact that the load carrying surfaces of the Fast coupling do not have a metal to metal contact.

J. Frank Lanning & Company, Pittsburgh, Pa., had two electric hoists, one 1,000-lb. and one 1-ton capacity. They also had a small roll of Krome Tan belt, a set of Stewart Brons bushings, and a few pigs of Motor Marine and Zero metals, Babbitrite compound and two babbitt ladles. A bearing was exhibited that ran for days under a pressure of 3,000 lbs. per square inch, 32,000,000 ft. per minute, and it was in perfect condition. This bearing was used on a 4½-in. shaft.

Fuller-Lehigh Company, Fullerton, Pa. The display exhibited by this company centered around pulverized coal as the general subject. There was a working model of the Fuller-Kinyon conveying system for pulverized coal which showed the general features embodied in this device; also, a working model of an electro-pneumatic switching valve which is used in the conveying system and which permits remote control of the fuel feed to all individual furnace bins by push button operation so that irrespective of the length or size of line and the number of furnaces or their respective locations, absolute control of the whole system is effected by the operator from a central switchboard conveniently located. There were small size models of the vertical and horizontal flare type burners, a small model of a vertical waste heat dryer and a small model of the Fuller-Lehigh pulverizer. Also photographs of the Drake Simplex unit type pulverizer, similar to the installation at Sherman Creek, New York City.

Homestead Valve Manufacturing Company, Homestead, Pa., exhibited the Homestead Quarter Turn Valve and the Protected Seat Hydraulic Operating Valve, also the Protected Seat Globe Valve.

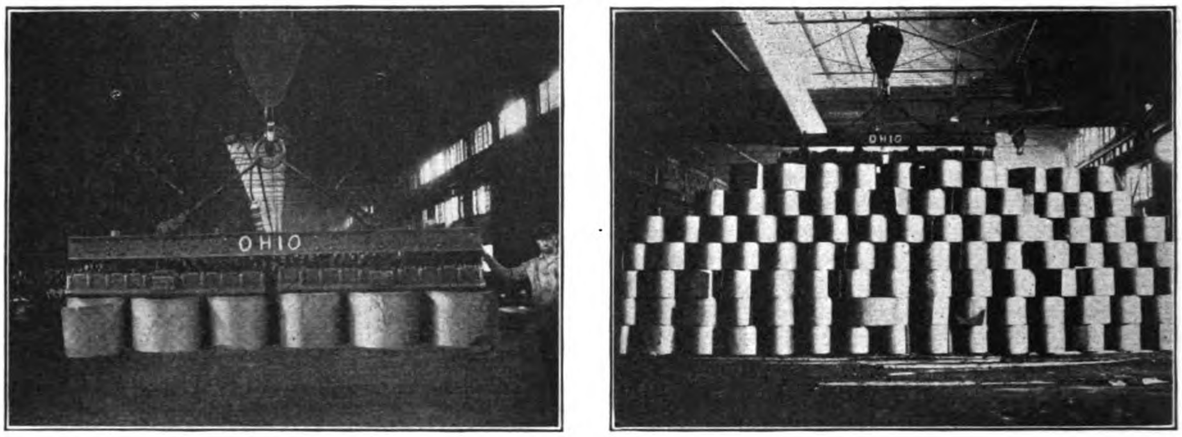
Homestead quarter turn valves are of the plug cock type, but have improvements which render them superior to other types of plug cocks on the market today. They are entirely sealed from leakage—bottom and top, the plug being placed in the body and sealed with a substantial packing gland. The plug is forced tightly to the seat in the closed position, and is held on the seat at all times by the improved locking cam. The Homestead valves of particular interest in the steel industry are the hydraulic valves for 500-lb, and 1,500-lb. pressure; the small size three and four-way valves for operating machinery by low pressure water, air, or steam; the large three-way valves, 4 and 6 in. for gas lines in open hearth and furnace departments; the Homestead-Hovalco conmbination blow-off valve, extensively used in boiler rooms; the protected seat globe valve for general steel plant service; and the protected seat hydraulic operating valve. The company was represented at the convention by Messrs. B. F. Schuchman, H. P. Ackerman and C. E. Powell.

Republic Flow Meters Company, Chicago, Ill. This company exhibited their full line of instruments for efficiency work on the power plants and steel mills. These instruments consist of recording, indicating and integrating steam, air, gas and water flow meters, as well as CO_2 recorders, and instruments for indicating and recording drafts and pressures. Also the Republic pyrometer, which is one of their latest developments, was shown for the first time at this exhibit.

Pittsburgh Electric Furnace Corporation, Pittsburgh, Pa. This company's exhibit consisted primarily of photographs of furnace installations, together with representative iron and steel castings made in the Electromelt furnace. The memory of their Electrified Foundry, erected in five days to feature last year's exposition in Buffalo, is still fresh in the minds of all iron and steel engineers.

Western Electric Company, New York, N. Y. This company showed many samples and display boards of the leading electrical supply apparatus and devices that they handle in a jobbing way. For instance, D and W fuses, Deltabeston wire, Victor friction and rubber tape, etc. In their exhibit room were copies of their general catalog together with catalogs, booklets and pamphlets on devices that were of interest to the steel engineers.

Doubleday-Hill Electric Company, Pittsburgh, Pa. This company exhibited buss renewable fuses, steel conduit fittings, manufactured by the Appleton Electric Company of Chicago, Ill., and distributors maintaining a large stock of Square D switches, Benjamin reflectors, Triumph motors, rigid steel conduit, Robbins & Myers fans, National X-ray reflectors, and American Steel & Wire Company rubber covered wires and cables. Special display of the new Ilg portable ventilating fans was given prominence.



An interesting illustration of floor space economy, by magnet operation.

M. H. Detrick Company, Chicago, Ill., exhibited a model showing a Detrick arch. This arch was the type used generally in connection with traveling grate stokers for the burning of anthracite and bituminous coals and coke breeze. The main features of the arch are: 1, Simplicity of construction; 2, Minimum number of shapes required, there being only two different shapes required for the complete arch; 3, Center suspended tile; 4, The construction of the fan ignition and the fan end arch. The construction of the main arch is the same that is used in connection with every type of boiler and stoker, and also in connection with heating furnaces and annealing ovens. There were on exhibit blueprints of interesting types of heating furnaces. Mr. Louis Ellman was in charge of the display.

Dravo Doyle Company, Pittsburgh, Pa. This company exhibited in operation the latest and most timely products of the American Engineering Company, the DeLaval Separator Company and the DeLaval Steam Turbine Company: Lo-Hed Monorail Hoists, plain and motor driven trolley. These hoists were so shown as to bring out their unusual mechanical perfection and accessibility as well as the low head room feature. DeLaval Portable and Stationary Transformer and Lubricating Oil Purifiers. The portable unit was shown in operation on transformer oil. DeLaval Worm Gear Speed Reducers; the latest type worm gears, especially designed and produced for industrial applications and including features of especial appeal to the practical operating man. DeLaval Flexible Couplings, an old established quality product, now rapidly increasing in popularity because they require no lubrication, are not affected by dust and are reasonable in cost. This equipment was selected for exhibition as representing in each case the latest developments of particular interest to the industrial electrical engineer. It has already been widely adopted by the steel industry.

The Electric Controller & Manufacturing Company, Cleveland, Ohio. The display of this company consisted of full magnetic controller with current limit acceleration and overload protection for blooming mill screwdown motor; full magnetic form "H" dynamic braking controller for hoist motion of electric traveling crane; Youngstown safety stop; Type Q brake; traveling nut type limit switch; a.c. and d.c. magnetic contactors; E. C. & M. automatic compensator; manual automatic compensator; Type NC 40 deg. squirrel cage induction motor.

"Cutler-Hammer Electric Elevator Controllers," is the title of an attractive 48-page booklet published by the Cutler-Hammer Mfg. Company of Milwaukee, Wis. This booklet, which is known as publication No. 3082, illustrates and describes many types of elevator control apparatus for passenger and freight elevators and emphasizes their simplicity, quiet operation, and smooth acceleration. Carbon-to-copper standardized power contacts are used which are interchangeable on a.c. and d.c. controllers of the same rating. Acceleration is obtained by time limit relays of simple design, which furnish the same comfortable smoothness of acceleration in spite of widely varying load conditions. A section is devoted to auxiliary apparatus for use with elevator controllers, which include reversing switches, floor selectors, various limit switches, car switches, and door switches.

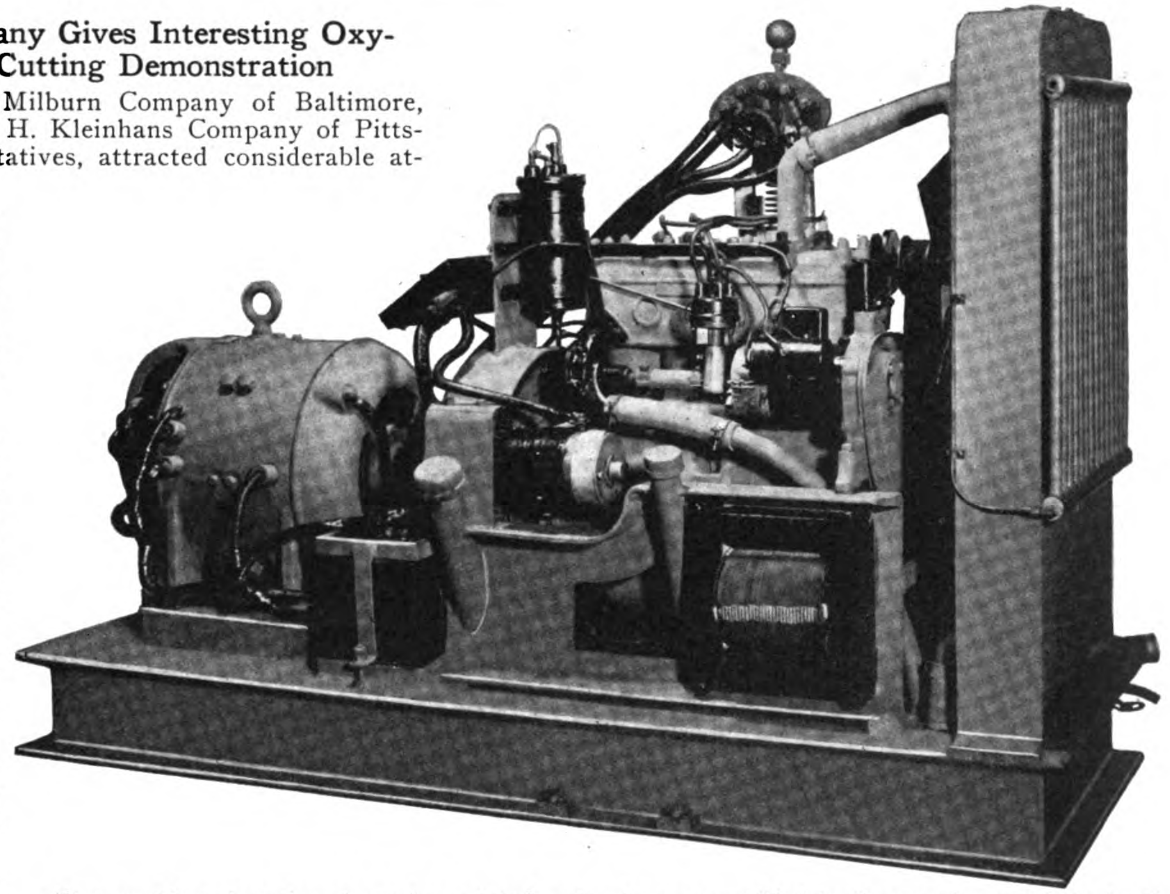
Milburn Company Gives Interesting Oxy-Acetylene Cutting Demonstration

The Alexander Milburn Company of Baltimore, Md., for whom the H. Kleinhans Company of Pittsburgh are representatives, attracted considerable attention and interest with their oxy-acetylene cutting demonstration, at the recent Iron and Steel Exposition, held at Duquesne Garden, Pittsburgh, Pa.

They particularly emphasized the non-back firing feature of the cutting torch. Their capable demonstrator pleased the ladies by cutting designs in 2-inch bars and edified those interested in oxy-acetylene cutting by slicing 6-inch axles and 6-inch billets without a flashback.

The Milburn Company claim that their torch cannot be made to flashback under any circumstances even in the hands of the most inexperienced operator.

They also claim a saving of upward of 20 per cent of fuel over other makes of torches.



That machinery in action always has a popular appeal was exemplified by the crowds around the booth of H. Kleinhans Company, Pittsburgh, Pa. This Company is manufacturing the Mann Electric Arc Welder. The Gasoline Driven Unit shown in the illustration was in actual operation, supporting a welder in an adjacent welding booth. This outfit has a number of interesting features, such as a self-starter, a new type of muffler that gives an almost imperceptible exhaust; the radiator guard, which is also a condenser; and the entirely unique Mann Electric Governor, a patented feature, giving the electric welding operator perfect control over his engine. The engine idles when no power is required, is brought up to speed by a button on the welder's electrode holder, and instantly takes full load when the welder strikes his arc.

The Mann Welder has just been placed on the market, and H. Kleinhans Company claim that it embodies a number of new and distinct features, all of which go to make the machine everything that such a unit should be. The features are perfect heat control in the arc regardless of variation in arc length, or in the leads; penetration, that quality in the arc which makes for homogenity in the weld and is especially essential in difficult work such as overhead welding; welding speed, and simplicity. The control is taken care of entirely by generator windings, the only outside adjustment being a rheostat for varying the amperage as may be required for different classes of work. In other words, they claim that their machine is practically fool-proof. A short circuit automatically reduces the load and can be left on indefinitely without harm. A motor generator set was also exhibited.

Trade Notes and Publications

The American Engineering Company of Philadelphia announces the following representatives for the sale of their Lo-Hed Monorail Electric Hoist: H. D. Betts, 406 S. Franklin Street, Syracuse, N. Y.; C. F. Bulletti Machinery Company, 67-71 Main Street, San Francisco; A. G. Gary, 410 Endicott Building, St. Paul; Chatard & Norris, 206 Water Street, Baltimore; Colwell & McMullin, Park Square Building, Boston; Coon-DeVisser Company, 605 Chamber of Commerce Building, Chicago; Dravo-Doyle Company, Dravo Building, Pittsburgh; A. Q. Dufour, Merchants and Manufacturers Bank Building, Milwaukee; Florandin Equipment Company, 110 W. Fortieth Street, New York; Fulton Engineering Company, 612 American Bank Building, San Francisco; S. A. Gilliard, 405 Liberty Building, Buffalo; E. C. Horne Machinery Company; 1751 Wazee Street, Denver; J-B Sales Company, New Haven; Lyman Tube and Supply Company, Montreal; J. R. Purser, 406 Commercial Bank Building, Charlotte, N. C.; Seeger Machine Tool Co., 260 Luckie Street, Atlanta; Solon Jacobs & Company, 2012 L. C. Smith Building, Seattle.

The Wilson-Snyder Manufacturing Company of Pittsburgh, Pa., have recently obtained an order from the Pan American Petroleum Company of Los Angeles for 10 pipe line pumps for their California field. Each pump is to have a capacity of 15,000 barrels per day against 750 lbs. per square inch line pressure and is to be driven by a 300-bhp. Deisel engine.

The Buckeye Steel Casting Company of Columbus, Ohio, have just put into operation a new normalizing furnace of the refractory tile recuperative type. It has a capacity of 180 tons of castings per 24 hours. The furnace is now operating on oil but is also fitted up to use gas. The Chapman-Stein Furnace Company, of Mt. Vernon, Ohio, were the designers and contractors.

The Jones & Laughlin Steel Company has placed an order for four completely mechanical gas producers with the Chapman Engineering Company of Mt. Vernon, Ohio. They are to be installed at the Woodlawn, Pa., plant.

The Gary Tube Company has placed an order with the Chapman-Stein Furnace Company of Mt. Vernon, Ohio, for furnaces for the new skelp mill now being built at Gary, Indiana. Each of the furnaces is to have a normal capacity of 20 tons of slabs per hour and is going in under a very low and rigid fuel economy guarantee.

The Automatic Control of Combustion. This new publication by the Carrick Engineering Company is a very thorough discussion of automatic control methods and systems. It brings out the limitations of the various systems and why they fail. It analyzes the conditions to be met in co-ordinating supply of steam with the demand and gives some very interesting charts of steam pressure. The fallacy of close steam regulation is exploded and the comparison between damper position and steam pressure brought out in a way that will surprise many engineers. Copies of this 32-page treatise may be obtained from the Carrick Engineering Company.

Systems for the Automatic Control of Combustion. In this 16-page bulletin published by the Carrick Engineering Company the complete specifications, together with diagrams and list of equipment required for 33 distinct methods of automatically controlling boiling room equipment are given.

This bulletin has been prepared primarily for consulting and designing engineers seeking accurate, authoritative and complete information in an accessible form. Thirteen different methods of controlling powdered coal are included. Each method is illustrated and described and the apparatus necessary listed.

This bulletin will be sent to interested parties free of cost, if application is made on their letterhead.

The National Tube Company has ordered 10 motors for driving the 14-in. and 16-in. continuous skelp mills at Gary, Ind., from the Allis-Chalmers Manufacturing Company, while the Westinghouse Electric and Manufacturing Company will furnish the alternating current switchboard, the Pittsburgh Electric & Machine Works the direct current switchboard and the General Electric Company a 1,500-kw. motor-generator set. Pinion and mill housings order has gone to the Wheeling Mould & Foundry Company.

The Lansing, Mich., Fuel & Gas Company is increasing the capacity of its condensing plant, and to that end has contracted with the U. G. I. Contracting Company of Philadelphia for the furnishing and erection of an 8-foot diameter U. G. I. high duty condenser. This condenser will be installed complete with latest type of temperature controls.

It is reported that the Laclede Gas Light Company of St. Louis, Mo., is installing U. G. I. heavy oil nebulizing system on the carburetted water gas apparatus at its Station "A" works.

The Northern Westchester Lighting Company is making extensions and improvements to its plant at Ossining, N. Y. Among the improvements will be the installation of a 7-foot cone top water gas apparatus for which the contract has been given to the U. G. I. Contracting Company of Philadelphia.

STATEMENT OF OWNERSHIP, MANAGEMENT, ETC., OF

The Blast Furnace and Steel Plant

[Required by Act of Congress of August 24, 1912]

Name of Publication: Blast Furnace and Steel Plant, published monthly at Pittsburgh, Pa. [Report of October, 1924.]

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Business Manager—L. L. Carson, 108 Smithfield St., Pittsburgh, Pa.

Names and Addresses of stockholders holding 1 per cent or more of total amount of stock:

L. L. Carson, 108 Smithfield St., Pittsburgh, Pa.
F. C. Andresen, 709 House Bldg., Pittsburgh, Pa.
C. J. Keller, 5840 Solway St., Pittsburgh, Pa.
R. H. Thiess, 426 Byrne Bldg., Los Angeles, Calif.
M. M. Zeder, 108 Smithfield St., Pittsburgh, Pa.

Known bondholders, mortgagees, and other security holders holding 1 per cent or more of total amount of bonds, mortgages, or other securities: None.

L. L. CARSON, Business Manager.

Sworn to and subscribed before me this 20th day of March, 1924.

CHAS. A. SEIBERT, Notary Public.

(My commission expires March 6, 1927.)

Some Pointers on By-Product Coke Oven Operations

Abstracts of Papers, Fall Meeting of American Chemical Society, Ithaca, N. Y.

(Continued from September)

A Study of the Mechanism of Absorption.

By R. T. HASLAM, R. L. HERSHEY and R. H. KEAN

The paper contains the results of work on an experimental absorption tower, the data having been analyzed with a view to determining the relative magnitude of the gas and liquid film resistances, and the variation of these with temperature and gas velocity. The ranges covered are from 10 deg. to 50 deg. C. and from .03 to 1.5 ft./sec. respectively, the gases studied being SO_2 and NH_3, with water as the absorbing liquid. The results indicate that under these conditions the liquid film is the limiting factor in SO_2 absorption.

The Quantitative Determination of Mists and Smokes With Special Reference to the Determination of Sulphur Trioxide Mists.

By HAROLD C. WEBER

In this paper some of the physical characteristics of mists and smokes are pointed out and reasons advanced why some of the analytical proceedings given in the literature yield inaccurate results.

Three methods of analysis for mists and smokes are presented all of which have been used in plant work with good results. The first of these involves the use of porous membranes immersed in a suitable liquid absorbing agent: The second the use of dry porous membranes and the third the use of a convenient portable form of low voltage Cottrell precipitator which was developed for this work.

Various sources of error in the use of these methods, especially in their application to the analysis of acid mists, are also discussed.

An Electrometric Study of the Use of Borax as an Acidimetric and an Alkalimetric Primary Standard.

By M. G. MELLON and V. N. MORRIS

Electrometric titration curves show that good end points may be obtained when using borax as a means of standardizing directly certain strong acids. When used in conjunction with sufficient mannitol, borax may also be used for the direct standardization of strong bases. For titrating acids the pH range of the indicator used should be approximately that of methyl orange, and for bases approximately that of phenolphthalein.

The Development and Application of Initiating Explosives.

By BENNETT GROTTA

The importance of explosives in our industrial system becomes apparent when it is realized that all of the great essential industries have been dependent, at some time or other in their development, on explosives or on other material obtained by the aid of explosives.

With the exception of black powder, all industrial explosives require for releasing their energy the action of a detonator containing a suitable initiating explosive,—itself capable of initiation by mere ignition. Shortly after Nobel gave to the world his idea of using nitroglycerine explosives for blasting purposes, he also found that fulminate of mercury was suitable for initiating his explosives. Since that time the history of detonators has consisted chiefly of a record of the efforts to produce an initiating explosive that is superior to fulminate of mercury.

Of the various attempts to displace fulminate composition detonators, the efforts to produce a booster type detonator appear to have made most progress. This detonator contains a booster charge of a highly brisant nitroaromatic explosive such as tetryl, which, in turn, is primed with a smaller charge of either fulminate of mercury or a fulminate substitute.

The azides, or salts of hydronitric acid, are initiating explosives superior in initiating value to fulminate of mercury. Recent developments indicate that the fulminate in the priming charge of the booster detonator may be replaced, either wholly or in part, by such azides as mercurous azide or lead azide.

The Control of Atmospheres as Regards Constituents Other Than Water Vapor.

By STERNE MORSE

Acid and basic gases and some neither acid or basic, form soluble compounds in water and such solutions are dependent for their partial pressure as regards the gas in question on the temperature and on the acidity of the solution. By holding the latter at a given value by introducing nonvolatile buffers any desired value for the partial pressure of the solution as regards the gas can be effected. An atmosphere brought in equilibrium with the solution in the ways familiar in the art of conditioning air as regards water vapor, will be conditioned as regards the gas or gases as the process is applicable to several gases simultaneously. The applications to several industries, the storage of food, procedures dependent on vital processes, the maintenance of given acidities in materials having extended surfaces such as drying gelatin, tobacco, etc. by a "buffered atmosphere" and finally the use of the method in chemical reactions between gaseous mixtures requiring certain concentrations of the reactancts are suggested.

Indirect Illumination for the Microscope.

By ALEXANDER SILVERMAN

The article describes a ring illuminator by means of which the sample under examination can be illuminated by light which strikes the surface at angles approaching grazing incidence. This light converges from all directions and gives an illumination which shows surface texture very well especially in the case of such material as paper, cloth, etc. The light unit consists of a single filament of tungsten mounted in a glass tube bent in the form of a ring. This is enclosed in a suitable reflector which rests directly upon the stage of the microscope. Good results are obtained with magnification up to 100 or 200 diameters. The application of this type of illuminator to various commercial problems is discussed.

St. Louis Coke & Iron Co. in Receivership

Under friendly proceedings filed in the United States district court of Springfield, Ill., a receivership has been established for the St. Louis Coke & Iron Company of St. Louis with James Duncan of Alton, Ill., president of the Litchfield & Madison Railroad Company, named by the court to handle the property. President W. G. Maguire of the St. Louis Coke & Iron Company has declared that the action, resulting from the depressed condition of the iron market and a shortage of working capital, was instituted to insure continuing operations by the present management. The blast furnace and by-product coke ovens of the company at Granite City are in operation and these plants and the business will be continued under the receivership. The receiver has arranged to borrow $300,000 to carry on the business.

The suit, resulting in the receivership, was instituted jointly by the St. Louis Coke & Iron Company and by the Iron Mountain Company, the latter claiming $45,000 due for ore. It is stated in the petition that the company has $6,763,000 in bonds outstanding and also $2,000,000 in other indebtedness, but that the assets exceed these liabilities. Stocks and bonds of the company total $11,581,477.

Perry Iron Company Will Build By-Product Coke Plant.

Contracts for a by-product coke plant of 30 ovens, with a daily capacity of 400 tons of coke, to be used by the Perry furnace, will be placed by the Perry Iron Company, Erie, Pa., controlled by Pickands, Mather & Company, Cleveland, O.

The Perry Iron Company has closed a contract with the Pennsylvania Gas Company, Oil City, Pa., under the terms of which the gas company will be daily supplied with 4,000,000 cu. ft. of by-product gas from the coke plant. The gas company will erect at Erie gas holders, purifying and mixing plants, and compressing stations for the blending of natural and artificial gas. It is estimated that the entire project will cost close to $5,000,000.

Magnitude of the Gas Industry

By Dr. J. B. Garner

(a) Natural Gas—In 1918 there were 2,508,543 domestic and 16,581 industrial consumers of natural gas. The volume of gas consumed was 721,000,959 M cubic feet—449,898,661 M cubic feet of which was consumed by industries and 271,102,298 M cubic feet was consumed by domestic consumers. The large volume of natural gas has the heat equivalent of 26,480,000 tons of bituminous coal. The total value of the gas as marketed was $153,553,650. There were required for delivery of the natural gas to the consumers more than 50,000 miles of pipe line, and 15,000,000 people living in more than 2,200 towns and cities in the 27 states were served with this commodity. The investment in the industry was more than $1,250,000,000. In order to supply this vast volume of gas it was necessary to have 40,500 producing wells drawing gas from an acreage of 14,575,457 acres with the assistance of compressing stations of an estimated brake hp. of more than 325,000. As by-products of the natural gas industry there were 282,535,550 gallons of gasoline and 43,500,000 pounds of carbon black produced.

(b) Manufactured Gas Industry—In 1918 there were 8,124,433 consumers of manufactured gas. The volume of gas consumed was about 380,000,000 M cubic feet. The total value of the gas was more than $450,000,000. There were required for the delivery of the gas more than 63,315 miles of pipe line. More than 48,000,000 living in 4,600 towns and cities in the 48 states were served. The investment in the industry was more than $2,750,000,000. In the making of gas in 1918 the gas companies used 9,000,000 tons of bituminous coal, 919,760,000 gallons of oil, 1,500,000 tons of coke and 2,000,000 tons of anthracite coal. As by-products of the manufactured gas industry there were 160,714,658 gallons of tar, 58,519,080 pounds of ammonia sulphate, 10,416,164 gallons of light oils and 545,003 pounds of naphthalene. The manufactured gas industry each day pays $200,942 in wages and salaries; spends $348,081 for all kinds of materials for gas making; buys $113,530 worth of coal; consumes $125,000 worth of oil; pays $50,000 for all kinds of taxes and rents and employs more than 65,000 people.

The Koppers Company, Pittsburgh, has been awarded contracts for extensions to the Alabama By-Products Corporation's plant. The work is scheduled to be completed by April.

New Junior Universal Iron Worker

A new junior Universal Iron Worker, designated as a No. ½ U. I. W. machine, has just been introduced to the trade by the Buffalo Forge Company, of Buffalo, N. Y. This unit has the same slitting, shearing, mitering and barcutting capacities as the larger No. 1 machine of this company, but the framework here is more compact, and in some instances the mechanical operating characteristics are changed slightly in design. The new unit is especially adapted to the smaller size machine shop where floor space is limited.

The main differences between the new Junior Iron Worker and the No. 1 and No. 2 machines of this company consist of a shorter throat, reduction in overall size of the frame, elimination of the high and low dieblock for punching girders and H columns, and substituting instead a combination dieblock for handling channels and beams as well as angles, tees and flat work. Two bracket supports also replace the one-piece subbase used with the larger machines. This latter necessitates construction of a 14 in. concrete foundation in order to obtain proper operating height of the machine. The 12 in. throat while limiting the capacity on sheet work, has made possible the compact frame (45 in. long x 46½ in. high) and small space requirements. The ram on the punch end is of new design, being made of square tool steel and hardened. In place of having a cast iron bushed connection to the rocker arm as used on the other punches, it engages with the rocker through a hardened tool steel seat. The connecting rod has been dispensed with, the eccentric engaging directly with the walking beam on the punch end; there is also a new drive shaft bearing, in which the drive shaft itself is mounted stationary on the machine, while the flywheel is keyed to the pinion. This in turn is equipped with a brass bushing and runs idle on the drive shaft. This shaft, together with the pinion, is made of chrome nickel steel; the gear is a steel casting, and the disks which form the bearing for the king pin are welded to the frame.

The barcutter and shear end of this Junior unit are practically the same as the Buffalo No. 1 machine, the slitting shear blades having four cutting edges, same as the larger machines. The life of the blade, therefore, is greatly increased. This new model has incorporated also the improved type of interchangeable motor and pulley drive arrangement. This makes possible a rapid change from motor to pulley drive without necessitating the removal of the shaft.

The construction of this Junior unit is the same as the older machines. The frames are made of Buffalo Armor Plate, having a tensile strength of 75,000 lbs. to the square inch. Bearings are bronze lined. All gears are machine cut. The shear is provided with knives for slitting plates of any width or length. The barcutter knives are made in five pieces, thereby making replacement easy and inexpensive. The capacities of the punches, shears and barcutters extend over a wide range. This machine will punch I beams and channels 5 in. to 15 in.; shear plates ½ in. thick, while the barcutter will shear rounds up to 1⅝ in. with the standard knives. Other capacities, such as for shearing flats, cutting squares, mitering angles, etc., range in like proportion.

The standard coping and 90 deg. notching tools can be furnished with this machine, as well as a triple punching attachment.

Accidents in the coke oven industry of the United States in the year 1923 killed 45 employees and injured 2,593, according to statistics compiled by the Department of the Interior through the Bureau of Mines. Coke manufacturers employed during the year 23,729 men, a larger number than was employed either in 1921 or 1922. The accident rate for the industry was the lowest in 10 years with the exception of the years 1915 and 1922. The reduction, however, was confined to accidents of a non-fatal character, as the fatality rate increased slightly as compared with the two preceding years. The accident rate for the year, based on 1,000 full-time or 300-day workers, was 102.94, of which 1.76 represented the fatalities and 101.18 the non-fatal injuries. The fatality and injury rates for the year 1912 were 1.59 and 93.77, respectively, and those for the 5-year period 1916-1920 averaged 1.81 and 167.03. Comparing the rates for 1923 with those for the 5-year period, the fatality rate in 1923 represents a reduction of 3 per cent and the injury rate a reduction of 39 per cent. The number of shifts worked by all employes (7,688,160) was likewise larger than in the other two years mentioned. The average days worked per employe, 324, has not been equalled since 1918, when the average was 329; the average for the five years, 1916-20, was 319.

In the number of men employed at coke ovens, the leading states were Pennsylvania with 8,101; Indiana, 2,394; Ohio, 2,124; Alabama, 1,725; Illinois, 1,566; West Virginia, 1,073; New York, 1,056, and Michigan, 1,043.

Ovens of the beehive type employed 8,515 men, who performed 2,143,363 days of labor, an average of 252 days per man. These figures represent material increases over 1922. Accidents killed 12 men and injured 875, indicating a fatality rate of 1.68 per thousand men employed (300-day workers) and an injury rate of 122.48.

By-product coke ovens employed 15,214 men who worked 5,544,797 shifts, an average of 364 shifts per man. These figures also indicate large increase over 1922. Accidents caused the death of 33 men and the injury of 1,718, representing a fatality rate of 1.79 and an injury rate of 92.95.

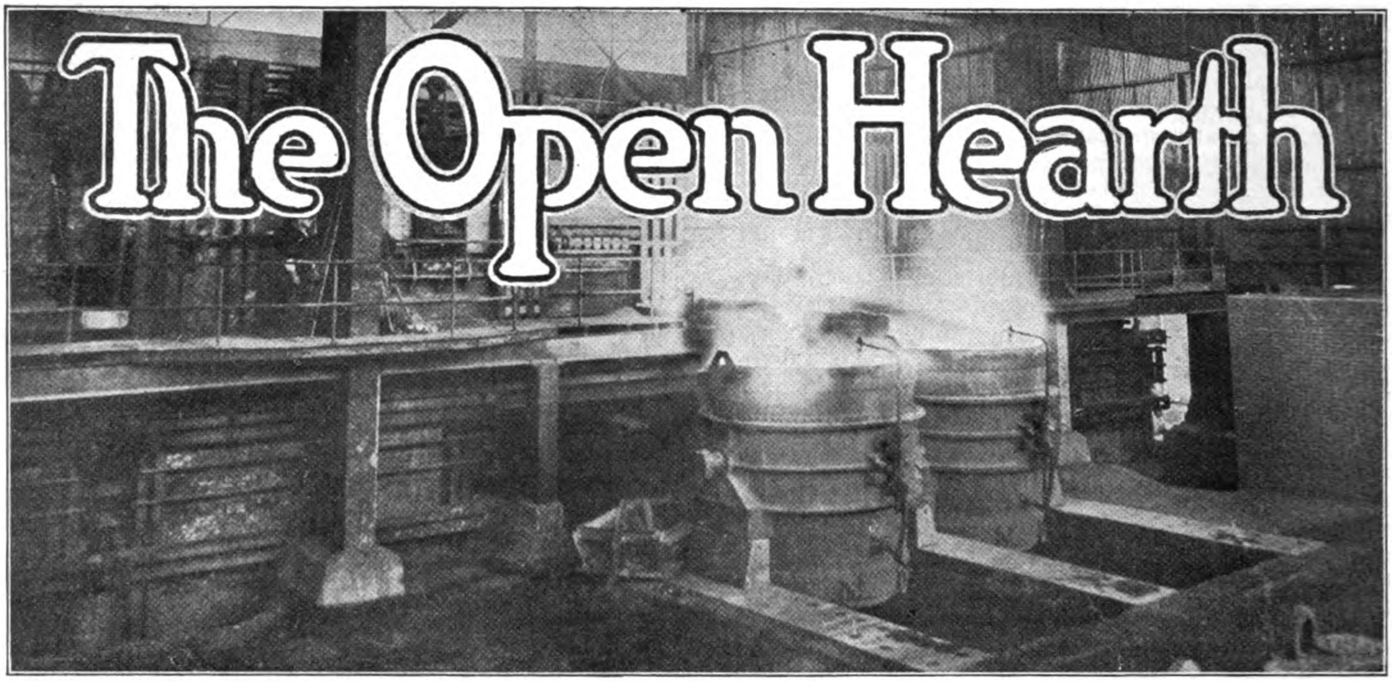
The main causes of accidents reported to the Bureau of Mines were falls of persons, burns, falling objects, hand tools, cars, larries and motors and coke-drawing machines.

Arthur G. McKee & Company, Cleveland, have been selected as engineers and contractors by the A. M. Byers Company in connection with the design and construction of a pig casting machine installation at the Byers Company's Girard, Ohio, blast furnace plant. The new equipment will include a single strand pig machine of the Heyl & Patterson type, 150-ton ladle crane as manufactured by the Morgan Engineering Company, and two 90-ton Pollock short pour hot metal ladles.

Carbonization of Coal in France

At the Fourth Congress of Industrial Chemistry, M. Ste. Claire Deville discussed the work carried out by the coking plant at Heinitz, with the object of improving the coke obtained by carbonizing the so-called "fat" coals of the Saar. The work led to the specification of a semi-coke used in the proportion of roughly one-eighth in preparing the mixture for improved coke, and to the construction of a fixed oven with turning paddles by the Societe de Fours a Coke. In addition a plant for primary tars under reduced pressure (one-fifth atmospheric) and able to treat five tons at a time was also devised. Numerous coke-ovens were tested, including a small rotary furnace resembling the large ovens of the same type used in the Ruhr. In this model the semi-coke is discharged at each half rotation by a hinged door which opens under its own weight, allowing the coke to fall. Despite the results obtained with this oven, at present trials are being carried out mostly with the Salerni plant, which includes two parts composed of semi-cylindrical elements with corrugated bottoms placed in parallel and having a common cover. The movement communicated to the mass by turning shafts (one for each element) does not take place along the axis of the cylinder but in a plane parallel to it, the result being to drive the particles of coal from element to element and finally to the discharge. The mixing seems much more complete than in rotary ovens, and the surfaces in contact with the hot walls are continually being renewed. With crushed Velsen coal 100 parts of dry coal yielded 13 parts of anhydrous tar and the semi-coke showed a content of 11 to 12 per cent of volatile matters. The mixing during carbonization thus seems to have a favorable effect somewhat similar to that of injected steam, the minimum temperatures at which distillation commences being reduced, so that heat is required and the plant lasts longer.

The administration of the Saar Mines is now building near Sarrebruck a small works for experiments on low-temperature carbonization, including plant for treating tar and liquid fuels. The plant includes two batteries of Salerni elements which can deal with 30 to 40 tons of fuel per 24 hours. A precise scientific programme has been mapped out for this new works.



The Open Hearth

Mr. L. C. Nicholson, superintendent of the rolling mill at the Brier Hill plant of the Youngstown Sheet & Tube Company, has resigned and accepted a similar position with the Wheeling Steel Corporation at LaBelle Works, Steubenville, Ohio.

Officials of the departments of the Ivy Rock Steel plant presented a silver loving cup to the former superintendent, J. E. Mountain, at a gathering held at the latter's home on West Sixth Avenue, Conshohocken. Superintendent Mountain recently severed his connections with the steel company after 22 years' service. He assumed charge of the plant at its completion in 1902, and was active until last month. Following presentation of the cup by the committee of 17, Mr. Mountain expressed his appreciation of the gift. He has just celebrated his sixty-ninth birthday anniversary.

Briggs & Turivas have just purchased all of the buildings, machinery, equipment contents, etc., of Brown & Company, Inc., Pittsburgh, Pa., manufacturers of rolled iron and steel products, consisting of 9-in. and 16-in. bar mills, a 20-in. sheet mill and a 20-in. muck mill and squeezer, and complete line of rolling mill equipment. The entire plant and equipment will be dismantled and sold.

Oscar F. Smith has resigned his position as chief chemist for the Atlas Steel Corporation, Dunkirk, N. Y., and has accepted the position of chief chemist and testing engineer with W. B. Coleman & Company, Philadelphia, Pa.

At the American Mining Congress, to be held in Sacramento, Cal., September 29 to October 4, the exhibition of the Link-Belt Company promises to be one of those outstanding for interest. It is the plan of the Link-Belt Company to erect and have in operation one of their new vibrating screens, as well as various other displays of Link-Belt equipment. The exhibit will be in charge of Mr. Shirley of the Link-Belt Meese & Gottfried Company, he being assisted by Mr. Strube, engineer from the Link-Belt Philadelphia works.

The Ohio Electric & Controller Company, Cleveland, Ohio, announce the appointment of Mr. G. R. Horne as their district sales manager, Magnet Department, 2158 Penobscot Bldg., Detroit, Mich.

Wm. Jessop & Sons, Ltd., tool steel manufacturers, Sheffield, have sold their interest in the Jessop Steel Company, Washington, Pa., and this company is now being reorganized under the American management and ownership. The branches of Wm. Jessop & Sons, Lt., of Sheffield in various parts of the United States and Canada, however, will remain under the control of the English company, which will continue to export its special tool and alloy steels to all parts of North America as heretofore.

A statement recently circulated in Great Britain to the effect that Wm. Jessop & Sons, Ltd., had disposed of all their American interests is officially denied. Only that portion of the business which was handled by the Jessop Steel Company has been sold. The English company will continue its business in the United States and Canada as usual, and at the same time the new interests which have purchased control of the plant at Washington, Pa., are planning to enlarge and develop their business in all branches of special and alloy steel manufacture.

Contracts for a continuous billet and sheet bar mill recently were awarded the Morgan Construction Company, Worcester, Mass., by the Youngstown Sheet & Tube Company, Youngstown, Ohio. The new mill will replace an older unit, which is claimed to be the first continuous type sheet bar mill built in this country. The present 18-inch billet and sheet bar mill was first operated in 1906; it has a rolling speed of 460 feet per minute and an output of 960 tons per turn of eight hours. The new mill will be designed with a rolling speed of 750 feet per minute and for a capacity of 1,600 tons of semi-finished steel per turn of eight hours.

NEWS OF THE PLANTS

The Penn Seaboard Steel Corporation, Franklin Bank Building, Philadelphia, Pa., is developing plans for expansion at its New Castle, Del., plant, and will concentrate all operations at this point in the future. The company disposed of its plant at Chester, Pa., some time ago, and is said to have arranged for the sale of the mills at Tacony, Philadelphia. The plant at New Haven, Conn., will also be merged with the New Castle works. Interest in the Rockaway Rolling Mills Corporation, Rockaway, N. J., recently has been sold. The expansion program will include the erection of new finishing mills at the New Castle plant, as well as the installation of additional furnaces and other equipment, estimated to cost close to $1,000,000, complete. It is expected to develop a large capacity, with employment of a number of additional workers.

The Youngstown Sheet & Tube Company, Youngstown, Ohio, is arranging a fund of approximately $10,000,000, for extensions and improvements in its different plants during the coming year. A large portion of the fund will be used at the East Chicago, Ind., mills, to include the erection of a number of buildings, additional machinery and blast furnace expansion. At the East Youngstown, Ohio, plant, a continuous sheet, bar, and billet mill will be built, and considerable new machinery placed in service. Work is now under way on a new sheet mill at the Brier Hill plant of the company, and it is purposed to push this structure to completion.

The American Tube & Stamping Company, Bridgeport, Conn., is perfecting plans for the early erection of a new continuous billet mill and high speed strip mill at ist local plant on Stratford Avenue. A site has been selected adjoining the open hearth furnaces for the new mills. The billet mill will be of 22-in. type, with building to be one-story, 70 x 120 ft. A traveling crane will be installed, and all equipment electric-operated. The strip mill will be likewise one-story, 70 x 300 ft., situated on the Yellow Mill Creek. The expansion is estimated to cost close to $500,000.

The Thomas Sheet Steel Company, Niles, Ohio, has work in progress on an expansion and improvement program at its local plant, formerly the property of the Youngstown Sheet & Tube Company. Two new mills are in course of building and it is expected to install equipment in the near future, including furnaces and accessory apparatus. Extensions have also been made in the rolling mills at the plant and it is purposed to place the additional capacity in service at an early date. The company has recently resumed close to full production at the sheet mills, giving employment to an increased working force.

The Bethlehem Steel Corporation, Bethlehem, Pa., will proceed with its expansion program at its Lackawanna plant at Buffalo, N. Y., and has authorized the installation of a new 28-in. structural mill, as well as a 35-in. roughing mill. New buildings will be placed under way at an early date, and list of accessory equipment arranged. The new structural mill will be electrically-operated and a contract for the equipment has been given to the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., at a price said to approximate $500,000. A number of new electric traveling cranes will be installed at the Lackawanna works, as well as at the Cambria mills at Johnstown, Pa., where a similar expansion and modernization program is now under way. The company has recently awarded a contract to the General Electric Company for equipment for a power house at the last noted plant, on which work will proceed at once.

The Vanadium Alloys Steel Company, Latrobe, Pa., has completed plans and will begin the immediate erection of a new addition to its local plant, to be one-story, 70 x 250 ft., to be equipped primarily as a hammer shop. A portion of the new structure will be given over to power plant service.

The National Tube Company, Frick Building, Pittsburgh, Pa., has plans in progress for the erection of a new two-story and basement building on Forbes Street, near Norwood Avenue. It will be 55 x 100 ft., and will be used largely as a laboratory for experimental and research service. It is estimated to cost about $75,000, with equipment. Edward Stotz, Monongahela Bank Building, Pittsburgh, is architect. The company is making extensions and improvements at its Gary, Ind., works, to include the installation of a battery of eight continuous furnaces for the new skelp mill, and auxiliary equipment. It is purposed to carry out this and other expansion at an early date.

The Indiana Steel Company, Gary, Ind., has commenced the rebuilding of its blast furnace No. 5, recently partially destroyed by an explosion, and will push construction so as to have the stack ready for service at the earliest possible date.

The Alabama By-Products Corporation, Tarrant City, Ala., has work under way on additions to its local coke oven and by-products plant, designed to increase the present capacity about one-third. In the coke department, it is expected to develop a total of 1350 tons per day, with large increase in capacity in the benzol and other by-products departments. A fund of about $1,000,000, has been arranged for the work, which is expected to be completed early in the coming year.

The Ford Motor Company, Highland Park, Detroit, Mich., has completed plans for the erection of an additional mill at its River Rouge steel works, and plans to begin work at an early date. The structure will provide for considerable increase in output, and is reported to cost close to $500,000, including equipment. Albert Kahn, Marquette Building, Detroit, is architect.

The Allegheny Steel Company, Brackenridge, Pa., has been making a number of improvements at its local plant and has recently placed in service a new electrically-operated steel melting furnace, with hearth capacity of 12,000 pounds. The unit has a rating of 800 kw. and operates continuously. Accessory equipment has been installed to accommodate the increased capacity. Other equipment betterments will be made to develop maximum efficiency.

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The Blast Furnace and
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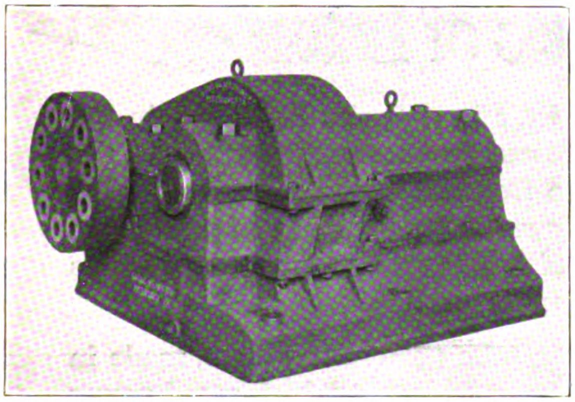
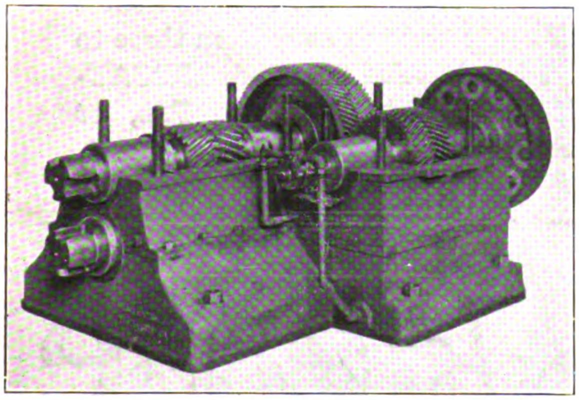
Fawcus Combination Herringbone Gear Reduction and Pinion Housing



This reduction is for driving a single stand 11″ finishing mill for a large southern steel maker.

This reduction is a recent development. The design confines in a single unit the transmission of power from the motor to the mill. The base plate of the pinion housing and gear reduction are cast solid, thus vibration is practically eliminated, and as a result wear, tear and maintenance costs are reduced to an absolute minimum. The saving of space and cost is apparent over separate pinion housing and gear reduction.

This gear reduction is part of a contract on which we furnished the largest Tandem Herringbone Gear Drive ever built for driving a 6 stand 16″ continuous bar mill, also one Tandem Drive for driving 4 stand 12″ continuous mill. All gear drives furnished with Fawcus Couplings for motor connections and Fawcus Universal and Fawcus Crab Thrust Collar Couplings for the mill connections.



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